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August 9, 1928

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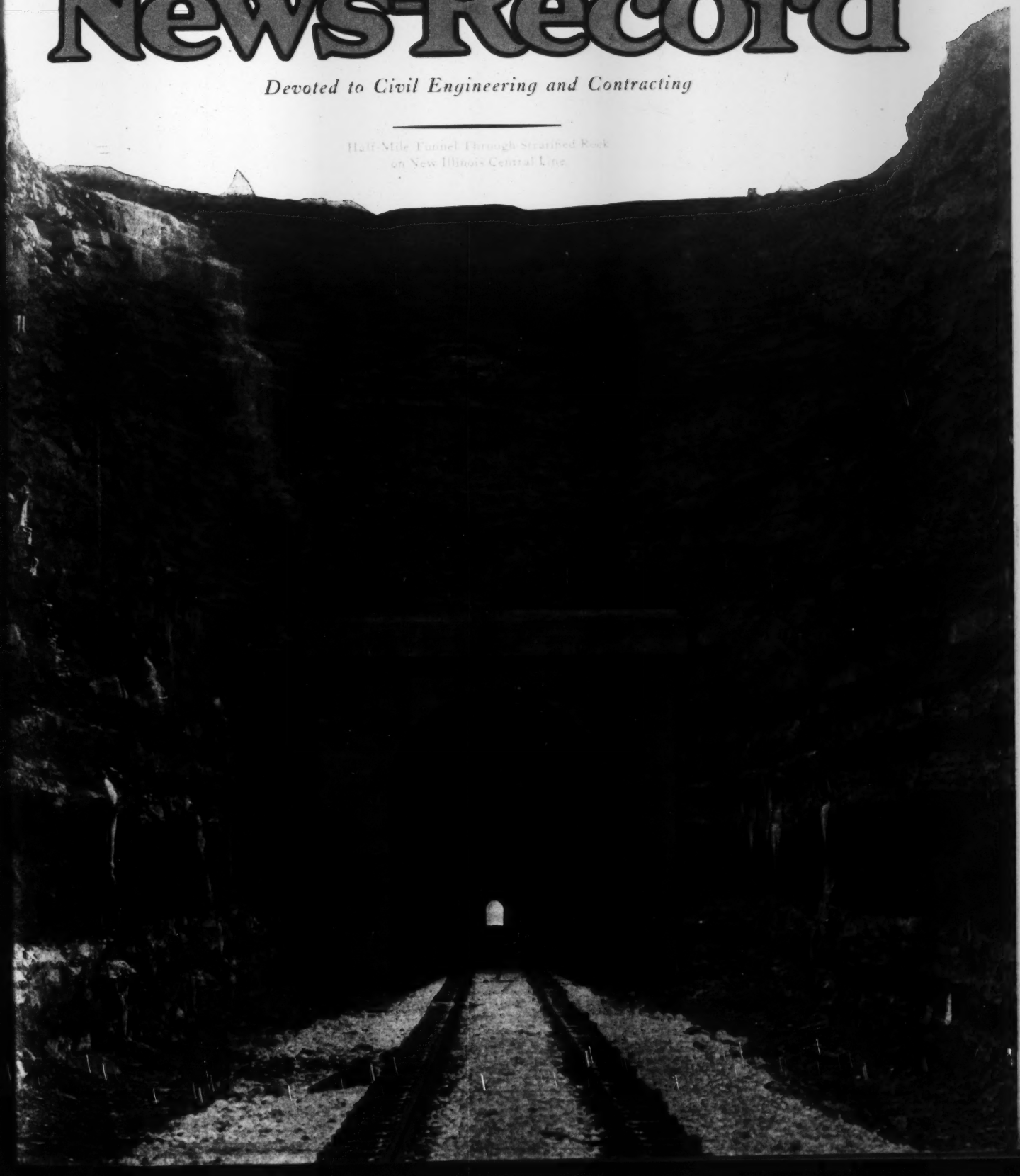
# Engineering News-Record

*Devoted to Civil Engineering and Contracting*

Half-Mile Tunnel Through Stratified Rock on New Illinois Central Line



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New York, August 9, 1928

# Engineering News-Record

*A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor*

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## *An Apology*

In preparing our double-page advertisement of July 12, featuring Raymond speed-records in constructing the San Mateo Toll Bridge, we forgot to mention that WADDELL & HARDESTY were the Engineers. We take great pleasure in acknowledging our debt to this and the other firms whose cooperation made our speed records possible.

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# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
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*General Manager*
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Volume 101 NEW YORK, AUGUST 9, 1928 Number 6

## *A Man Departs*

FOLLOWING close on his retirement from the arduous service to which eight of his best years had been devoted, the death of Gen. Charles L. Potter comes as a peculiarly regrettable event. His brilliant service as head of the Mississippi River Commission during a period when two of the greatest floods of history swept the valley made him conspicuous the country over. The closing year of that period saw his complete restudy of the problem of controlling the river, a study which, we feel confident, was to initiate a new stage in the river's engineering history. Even before this labor was ended he found it necessary to uphold his conclusions in an admirably courageous stand against strong political and organizational pressure, whose final outcome was his removal from the work he loved. The development of the Mississippi Valley loses a strong, constructive force through his passing. And civil engineering loses a true man—an able mind, an upright and friendly character and a courageous spirit.

## *Technical Discussion*

DURING the last decade society activity in the engineering field has been developing rapidly. Today it is clearly an essential agency of professional growth. Yet one of its basic elements—namely, discussion—has lost rather than gained vigor as the development proceeded. Meeting after meeting shows only anemic attempts at comment and exchange of opinion concerning the problems dealt with in the prepared papers. Lacking the stimulative massing of experience through pertinent discussion, technical meetings become mere lecture sessions —by no means the best return for the large investment of time and thought which the meetings represent. Is increasing specialization at fault, or are we becoming a silent profession? Are program arrangements such as to inhibit discussion through overcrowding and lack of time? Doubtless all of these factors play a part, but more probably habit is the determining influence. And this habit is shaped almost wholly by the older men. Where the seasoned veterans of the profession are content to sit as silent hearers, juniors are unlikely to venture upon debate. If we are to have a revival of technical discussion, then, it is to the elders that we must look for leadership in the movement. Certain it is that the society which makes a start toward reanimating discussion can look for large returns.

## *Bad Building Habits*

NECESSARY as they are, building operations are but little liked by the rest of the world. They infringe on both private and public convenience. The builder, in effect, steps on everyone's toes. His work is noisy and dirty, so much so that quite apart from higher esthetics it is a common nuisance. Worst of all, he boldly preempts public sidewalks and streets with his offices and storage sheds, his piles of lumber or gravel, and even his concrete mixer and his mortar trough. If the noise and dirt are more or less inevitable, trespass on public space is far from being necessary. In part it merely simplifies and cheapens the builder's operations; in part, also, it is the outgrowth of slipshod habits and poor system rather than any more positive cause. Formerly, when streets were less used, it was not particularly serious so long as no thoroughfare was actually closed. Today, however, the importance of street space has become so great that the confiscation is a genuine public deprivation. Though builders can hardly be unaware of the change, their practices continue as they always were. Meanwhile a definite public dissatisfaction with these conditions is taking shape, and only the notorious slowness of public resentment to become active is responsible for the fact that no action toward checking these building practices has yet been taken. As it is, the building industry is in the fortunate position of being able to work out a reform on its own initiative. It has an ideal opportunity for applying the principle of industrial self-regulation. Building is already beset by many restrictions and has nothing to gain by running the risk of adding to their number. Due foresight, accordingly, would counsel early reform from within the industry.

## *A Government Journal*

BOTH technology and science, swept along in the rapid advance of knowledge, find difficulty in arranging their current literature for easy access. There are opposing trends: on the one hand toward segregation of specialized literature, on the other toward comprehensive publication. The new publication policy of the American Society of Civil Engineers, which we discussed last week, follows the former trend. In contrast with this decision in favor of segregation, the Bureau of Standards announces a consolidation of its separate scientific and technologic papers into a periodical magazine, the *Journal of Research*. So far as we understand the reading habits of engineers, we should be inclined to doubt whether those who use the bureau's technologic papers as data will find the change convenient, since it will group together unrelated material, of which only a small part is of interest to any one engineer. The attitude of scientists may be quite different; yet even in the scientific field there is evidence of a growing demand for segregation rather than grouping of current literature, as shown by recent efforts of geologists to arrange for regular publication of an abstract-bibliography of their field. The bureau's new plan presumably owes its origin to administrative reasons, economy and the like. In the end, however, the new journal will have to stand or fall on the criterion of improved service to the users of the matter published. The new departure raises an interest-

ing question of broader scope—namely, whether the national government is well adapted to exercising the functions of editor and publisher; but discussion of this question is hardly pertinent to the point we have raised. For the engineering student of new test and research data the essential fact is that he will in future have to find buried in a periodical magazine the papers heretofore available to him as separate pamphlets. Unless this disadvantage is compensated by countervailing advantages not now apparent, the new magazine will not serve engineering needs as effectively as the present publication system.

### *Red for Danger*

STREET and road safety rightfully engages much attention these days; it is, in fact, one of the most disturbing questions of the present age of road traffic. Fortunately much work, and very effective work, is being done upon it; and the results are perhaps better for being mainly the product of practical evolution rather than paper study. If safe traffic movement had to await the formulation of abstract rules, we should be in worse trouble than we are, for the study progresses but slowly. However, practical development falls short in some important particulars, and one of these is the safeguarding of the red light as a danger signal. Both efficiency and safety of traffic are rapidly coming to depend on the authority of the red light. Denoting an obstruction, a break in the road, a cross-stream of traffic or some other warning of immediate danger, it carries an unqualified message of STOP. But this imperative authority of the red light is weakened by its free use for other purposes—decorative, advertising and the like. The non-essential red lights distract attention from the essential ones and tend to bring about inattention to light signals. The evident menace of this confusing use is on the increase. Matters have reached such a point that an important improvement in traffic safety would be brought about by abolishing the use of red lights within sight range of street and road traffic for anything but traffic stops or equivalent warning use. No doubt a way to bring about such restriction could be found, whatever legislative or legal methods may be necessary. It is one of the most seriously needed safety measures of the day. Something of the same kind might be said with respect to safeguarding the use of the inscription "Stop," and the use of flashing lights, whose warning function at grade crossings is of an importance overshadowing any claims of private advertising desire. But the case is so greatly the strongest for the red light that this is the point at which to make a beginning.

## *Airport Campaigning*

CAMPAIGNS for airports and the subsequent selection of a site are matters of current importance in nearly every American city. Recent experience demonstrates certain fundamentals of such campaigns—the most important being that, in due sequence, economics, engineering and politics must be applied to the problem. It will be well for engineers and public officials to realize this truth, and particularly to appreciate the part that politics should play. While the uncertainty surrounding any new enterprise makes airport selection susceptible to political manipulation, yet political experience is an essential element in the campaign, once the site is chosen.

An excellent example of a proper attack on the airport problem is furnished by Kansas City, where a million dollar bond issue for use in purchasing and developing a site has just gone through its political campaign. A site was first selected on the basis of economic and engineering analysis. Viewed in the light of such a study, the advantages of the proposed site were plain, as were the reasons for wanting an airport. Yet past experience often shows facts obvious enough to many that are ignored by a majority on election day. No one knows this better than the man of political experience. And no one knows better how to guard against it.

So in Kansas City with the site first logically chosen the airport campaign was literally turned over to the city's civic leaders. Their job was to create interest and get votes; no one can approach these gentlemen in proficiency at that particular task. A novel plan for booming the airport as a site for airplane factories and allied industries was developed: rent to be charged on a basis of percentage of gross sales, so that in its pioneer days an industry can be blessed with low rentals which will increase only with the growth of business. For the week preceding election free airplane rides were offered to hundreds of citizens in order to create a general feeling of airmindedness. And behind it all was a constructive program of newspaper publicity and political activity that kept the subject alive.

Many cities need airports. Also many others do not. But once the need is apparent, Kansas City's methods may serve as a model of how to proceed.

## *Air-Rail Travel*

REGULAR air-rail passenger service between the East and Northwest is scheduled to begin about the middle of August. Passengers leaving New York on fast evening trains for Chicago, upon reaching that city in the early afternoon of the following day, may thereafter be taken by airplane to St. Paul in about three and one-half hours of flying time, to connect with the night train for the Coast. Similarly, eastbound passengers arriving at St. Paul or Minneapolis in the morning may fly to Chicago, arriving there in time to connect with the fast noonday trains for New York. This is the first definite step in a plan to establish the combination air-rail passenger service between the Atlantic seaboard and the Pacific Coast cities which some weeks ago was announced as being in prospect.

Long-distance airplane travel to be satisfactory requires sleeping accommodations as well as more elaborate provision for feeding passengers than is necessary on trips of only a few hours' duration. Planes built with such facilities are in use in Europe but are of limited capacity and costly to operate. The plan which is to be put into effect in this country as worked out by the Pennsylvania Railroad and the Transcontinental Air Transport avoids the use of such planes by combining air travel by day with train travel by night. In theory, passengers will leave by train at night, travel all night in a sleeper and in the morning transfer to an airplane, to fly all day to some convenient point whence they may continue their journey by night train. In practice, as in the Chicago-St. Paul trip, the flying time will have to be adjusted to suit existing train service, at least until the air-rail service grows to proportions where it will warrant special train service.

Experience alone can tell how successful such an ar-

rangement will be. At first thought it does not seem as if enough people would make use of the service to make it worth while, but when one reflects upon the number of sections in which the extra-fare trains between New York and Chicago are run, or upon the extent to which the transatlantic telephone service is used despite its cost, or upon the thousands of letters for which people hitherto paid five times the normal postage rate in order to gain a day or so in delivery, one hesitates to predict that this air-rail passenger service will not be a success.

The ever-increasing use of airplanes for the transportation of men and materials is indicative of the increasing value of time. If the new service provides a reasonable amount of comfort and at the same time assures to the passenger a gain of even a day in time, it may be that enough people will find the service of sufficient value to make it a paying proposition. Unlike the air-mail service, it cannot long be run at a loss in order to build up the business to a point where rates may be reduced to further stimulate travel. Lack of a government subsidy and the great distances to be covered have kept airplane passenger travel in this country at an insignificant figure as compared with Europe. Possibly this new air-rail service may be the first step in building up a demand for airplane passenger service in this country which will be sufficiently great to offset some of the present disadvantages.

## *Merchandising Concrete*

THE vending of ready-mixed concrete dates back a dozen years and today commercial plants are retailing concrete in a dozen cities. The central-mixing business described in this issue, then, is exceptional only because few plants are so complete and are directed with such precision. Such a development, as it extends, will present a new problem in construction; it will call for a different plan of design and control by engineers and a new set-up of equipment and working forces by contractors. In particular it will definitely alter the market for equipment and materials. Even in its present tentative stage the sale of ready-mixed concrete is disturbing the market of dealers in small mixers, dealers in cement and producers of sand, gravel and stone for aggregates. For all of these businesses the central-mixing plant which merchandises concrete steps between the dealer and the consumer and absorbs the dealer's functions and profits.

There are now relatively few communities where the making and selling of ready-mixed concrete has grown to recognizable volume and monetary importance. But the business is just being learned. Where it has been mastered it is meeting a demand, is growing in favor with engineers and builders and is netting its owners at least some profit. In Pittsburgh, as the article in this issue relates, ready-mixed concrete has within three years come to be accepted without prejudice for the most important public and private construction work. It is accepted in the specifications for city public works, by the city bureau of building inspection and by the Allegheny County department of public works, now carrying on one of the largest programs of bridge and paved road construction being undertaken the world over. It is accepted widely by architects and engineers in private practice and is being bought freely by contractors and industrial plants for large operations.

The situation should not be misapprehended. It is only where the manufacture and vending of ready-mixed concrete is maintained on the highest plane of knowledge of concrete design and control that it promises engineering success. This means plants equipped with every proved mechanical device for control under all variations of materials, weather and conditions of delivery. It means informed and conscientious plant management—the scientific production of concrete. In particular, it means perfection in transportation with the purpose both of preventing segregation and of increasing the safe distance interval between mixing and placing. Already ways of accomplishing both objects are being worked out. Indeed, the difficulties of segregation have been virtually overcame by the special dump truck described in this issue and by trucks with agitator bodies. The problem of extending the safe hauling time has to be demonstrated by experiment. Tests under way indicate that much longer transportation periods than users so far have been willing to allow can be employed with entire safety.

So far commercial concrete production, with occasional exceptions, does not come up to these standards. Commonly such enterprises have been undertaken in a tentative way as a means of utilizing the surplus capacity of a plant producing chiefly for other uses or to retail concrete for the many uses where refinement in quality is not in particular demand. Even in these cases the buyer probably gets a better concrete than the average small builder and odd-job concrete worker gives him, but it is not the rigidly controlled product which good engineering demands. To insure this product, highly perfected plant equipment and plant direction are required. The highest usefulness of the ready-mixed concrete business to the engineering constructor depends upon his ability to buy with absolute confidence that his demands will be fulfilled without constant espionage on the producer.

If the business is to mature on the highest plane, then, it must be sponsored by broader interests than have with a few exceptions so far sponsored it. Its logical sponsors are the materials producers and particularly the producers of aggregates. Indeed, there is evidence that sand, gravel and stone producers are awakening to the opportunity for profit and commercial control which lies in owning and directing all processes from the gaining of the raw materials to the forming of the finished product ready for installation by the builder. Certainly they have plenty of precedents to justify such planning. With this development, too, there comes to the engineer greater certainty of quality and uniformity and greater assurance of understanding aid in his efforts to improve the materials with which he builds.

In all respects ready-mixed concrete is a promising development. It meets the conditions of construction in cities particularly well. Its quality control can be assured. It offers economies in quantity production. It centralizes and reduces supervision. There are obvious limitations to its use imposed chiefly by transportation. There are many merchandising problems to be worked out. The greatest need of the business is centralization and concentration in the hands of producers who control all processes from the raw materials to the manufactured product. And there is promise of this development in the near future. Altogether the commercial production of ready-mixed concrete has reached a stage where it commands the thoughtful consideration of engineers and contractors.

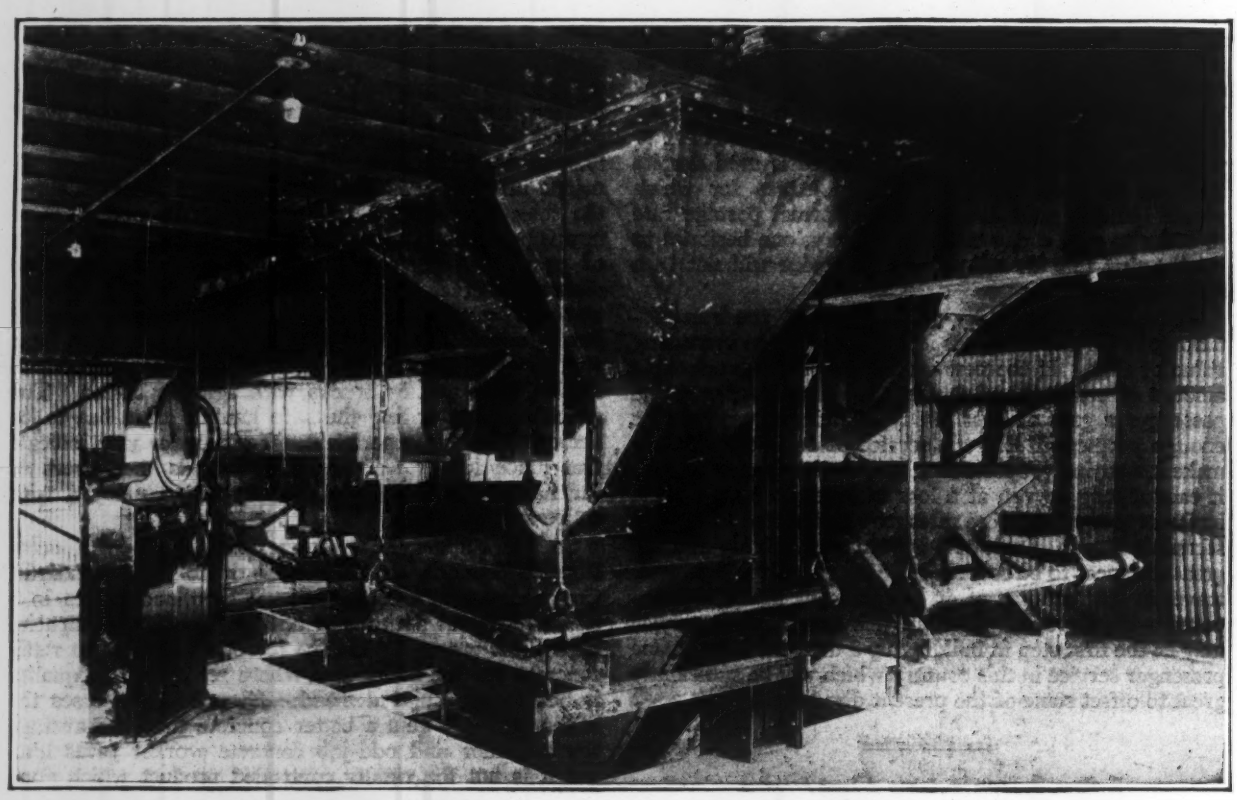

Fig. 1—Operating Floor of Ready-Mixed Concrete Plant

# Developing a Ready-Mixed Concrete Business

## Solving the Peak Load Problem—Insuring Designed Concrete—Correcting Segregation in Concrete Delivery—Developing the Engineering User—Economic and Business Conclusions

By Edward N. Jones
*President, Ready-Mixed Concrete Company, Pittsburgh, Pa.*

In 1924 the writer's attention was directed to the possibilities of merchandizing pre-mixed concrete. From his investigations he concluded that here was a new field of operation for the dealer, rich in possibilities, provided the transporting of the product could be accomplished without loss of plasticity and with segregation eliminated or reduced to a minimum and provided the point of delivery was not too far removed from the point of manufacture.

At that time there were only a few central-mixing plants in existence and the transportation of concrete was effected in ordinary dump trucks. Only the very dry mixes could be handled, thereby limiting the use of this material to foundation work or mass use where low slumps were specified.

*Plant Growth*—Such were the conditions when the writer's company began operations in Pittsburgh in May, 1925. The first plant consisted of 1-yd. mixer with necessary storage bins and elevators. For the first two months of operation the output was about 400 cu.yd. per month. During the third month the sales jumped to about 2,000 cu.yd. and in the succeeding months of the year maintained the same quantity.

Speculating on the annual yardage that might reasonably be produced in a 1-yd. plant, it was believed that a mixer of this capacity would permit of a great volume of business, but it was soon discovered that while, theoretically, the capacity of a 1-yd. mixer is about 250 cu.yd. per ten-hour day, it did not by any means follow that in a month of 25 days a ready-mixed plant of this size could turn out 6,250 cu.yd. The obligation to be ready to furnish simultaneous service to all contractors who have placed orders for ready-mixed concrete means one of two things:

1. Limiting the business taken to a fraction of the capacity of the mixer, or

2. Increasing the mixer capacity so as to be able to take care of all peak loads that may suddenly develop.

Assuming that the plant has received three fair-sized contracts any one of which may require 100 cu.yd. per day, it can readily be seen that if the three contractors should call for concrete at the same time a 1-yd. mixer could not take care of the load.

In the winter of 1925 it was decided to increase the capacity of the plant, and a new unit was constructed. The building was of reinforced concrete housing a

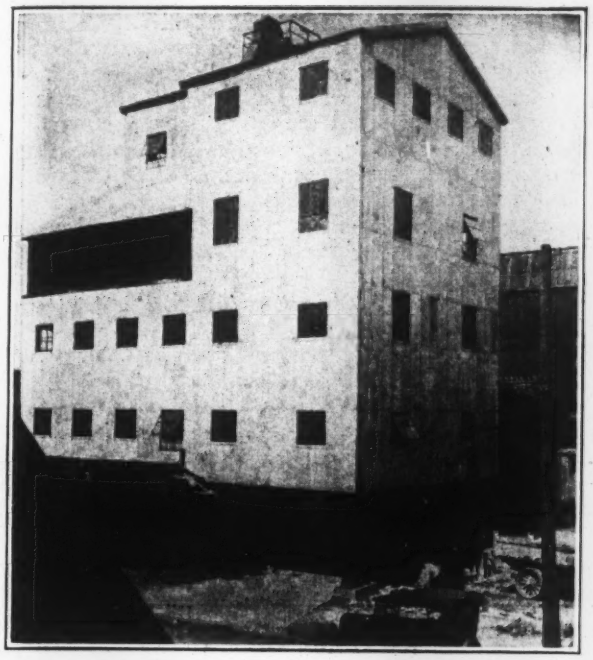

FIG. 2—READY-MIXED CONCRETE PLANT IN DOWNTOWN PITTSBURGH

3-cu.yd. mixer with provision for the storage of three classes of rough aggregate, one class of sand and one of cement. The second unit was placed in operation about June, 1926. It was far ahead of the old plant in economy and flexibility of operation. Sand and cement were weighed and the gravel was measured by volume.

As business increased, demands were made for favored brands of cement. Only one cement storage bin had been built, and as it was for bulk cement it was impossible to handle more than one kind. So long as only small yardages were involved in requests for special brands, it made little difference, as they could be ignored, but there came a day when the problem had to be met: either pass up two jobs each calling for several thousand barrels of cement or else provide overhead storage bins for two other brands of cement. Needless to say, the additional bins were constructed. However, unless radical changes are made in central-mixing plant design it is doubtful if more than three brands of bulk cement can be handled economically at any one plant.

Following increased demands for ready-mixed concrete during the fall of 1927, work was commenced upon the erection of a new plant (Figs. 1 and 2) situated in the heart of the downtown section of Pittsburgh. This unit was placed in operation on June 1 this year and is of the same capacity as the South Side plant having a 3-yd. mixer with bins for three classes of aggregate, one for sand and two for cement. In both plants bulk cement is used. The material is pulled out of a box-car with a power shovel into a cement pump, which delivers it through a 4-in. pipe into the cement bins.

*Correcting Segregation*—The first experience of the company in concrete transportation was with six second-hand 1½-ton trucks on which were mounted 1-yd. tip-over dump bodies. These bodies were tapered upward and when dumped made a half revolution. It was thought that by using such a tapered container there should be no difficulty in discharging the concrete. It was found, however, if the concrete exceeded a 2- or 3-in. slump, that the segregated fluid in dumping would spill out in all directions and the remaining material would have to be dug out with picks or other sharp tools. These bodies did not last longer than a few weeks by reason of being damaged by the shock of turning over and the efforts of the workman to get the concrete out of them.

This experience was followed by making a contract with a trucking company which provided ordinary dump trucks with tapered bodies having rounded corners. The trouble with segregation still continued when wet mixes were transported. At the same time it was becoming more difficult to sell ready-mixed concrete to contractors, because only dry mixes could be successfully hauled, thus compelling the contractor to go to greater expense in placing the concrete than if he had mixed it himself.

In July, 1926, experiments were begun with a new type of body which was nothing more or less than a 3-yd. bottom-dump bucket mounted on a 5-ton chassis that discharged its load between the chassis frame, about 60 per cent over the rear axle and the remainder through a chute over the transmission directly between the wheels of the trucks. Results with this type of body justified the equipment of a fleet of nine additional trucks with similar containers and in August, 1926, the problem of delivering concrete was in a fair way of solution. With these bodies, concrete of any desired slump could be transported and discharged without loss of time or serious segregation.

The main objection to this type of body was that it made the trucks special equipment and as special equipment the operating efficiency could not be obtained that would have been possible had the bodies been available for the hauling of sand, gravel or other materials. Because of this, experiments were again undertaken to find a body that would be more effective if possible in

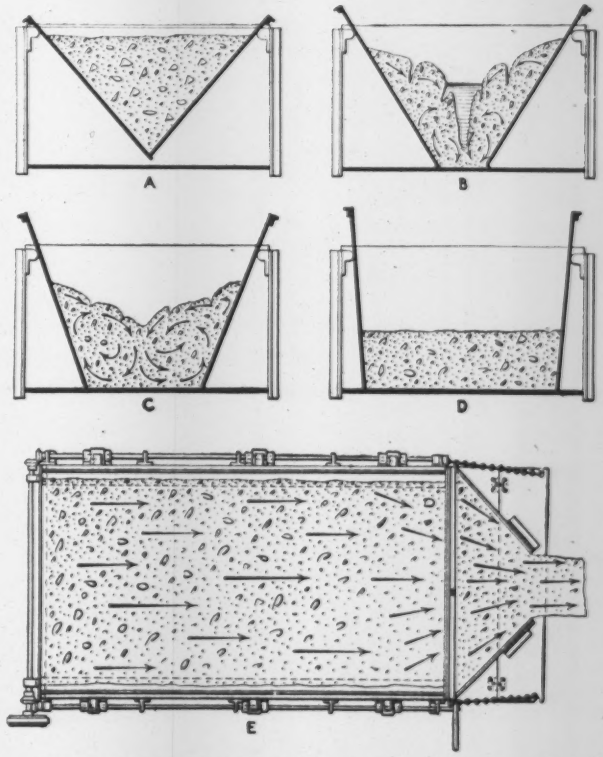


FIG. 3—OPERATION OF SPECIAL BODY CONCRETE TRUCK

transporting concrete and could in addition be used for all general material delivery purposes.

As a result of long and costly experiments a new type body has been developed which is essentially an end dump on which are mounted two movable plates which form the sides when in a vertical position and which can be brought together to form a V. While the sides are in this V position (Fig. 3*a*) the body receives the load of concrete which is hauled to the job and discharged by winding the movable plates back (Fig. 3*b*) to the vertical position, thus dropping the concrete onto the floor of the truck (Fig. 3*c* and 3*d*). Any segregation which might have taken place en route is corrected in this turnover. Further reconditioning takes place by the peculiar design of the end gates, which are separated in the middle and upon being opened form a chute (Fig. 3*e*) through which the concrete, when the body is elevated, pours in as plastic and workable a condition as when it left the mixer.

So successful has been the operation of these trucks in the transportation of concrete and so economical by reason of their availability in hauling sand and gravel that the company has now in operation a fleet of twenty trucks with this type of body. The truck is shown in operation by Fig. 4.

This body is built by the C. O. Bartlett & Snow Company, Cleveland, Ohio, which also manufactures the water tank described below.

*Mix Design and Control*—One of the interesting features of the new plant is a water-measuring device developed by the writer. Briefly it consists (Fig. 5) of a cast-iron tank bored to an accurate diameter, having a total capacity of 150 gal. Water enters through a float valve which shuts off the water when it reaches the zero mark at the top of the water glass. Through a quick-acting lever valve at the bottom of the tank water is drawn off into the mixer.

Mounted adjacent to the water glass is a hexagon brass rod, each face of which is calibrated for a certain water-cement ratio. The ratios used are 1.0, 0.9, 0.8, 0.7, 0.6 and 0.5. The hexagon scale rod is rotatably mounted so that the desired scale is brought into juxtaposition with the water glass. The markings on the scale are in

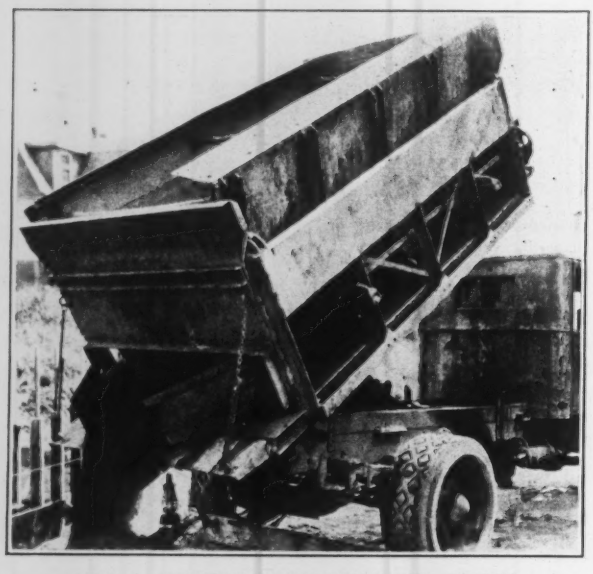

FIG. 4—SPECIAL BODY CONCRETE TRUCK IN DUMPING POSITION

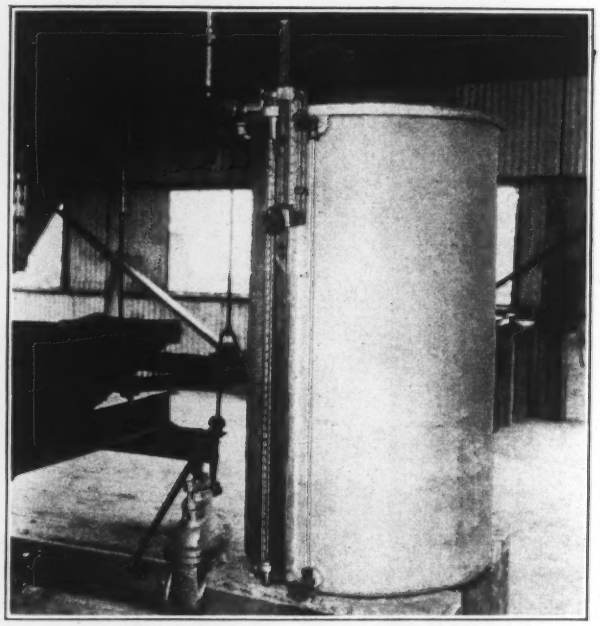

FIG. 5—WATER-CEMENT-RATIO WATER-MEASURING TANK OPERATING SCHEME

pounds of cement. The operating scheme is as follows:

Assuming that a water-cement ratio of 1.0 is specified, the hexagon scale rod is rotated until this particular scale appears. Suppose there are 940 lb. of cement (10 cu.ft.) in the mix, the movable pointer is lowered or raised to the 940-lb. mark. Another movable pointer when in the same horizontal line as the pointer at the 940-lb. mark points to an elevation on the water glass, and if the water in the tank is drawn off from the zero mark to the point indicated, 10 cu.ft. of water will have been put into the mixer.

Turning the scale to the 0.9 calibration, the mark 940 lb. is higher up and when the movable pointers are brought into position the corresponding amount of water indicated will be 9 cu.ft. and so, as the other scales 0.8, 0.7, 0.6 and 0.5 are brought into use, the indicated amount of water is decreased accordingly. The second pointer, which is adjacent to the water glass, is mounted on a secondary scale permitting quick deduction for moisture in the fine aggregate.

*Business Growth*—As evidencing the favor with which ready-mixed concrete is viewed in Pittsburgh, it may be stated that Charles Reppert, chief engineer, Department of Public Works; Richard Neff, chief engineer, Bureau of Inspection, and P. J. Freeman, chief engineer, Bureau of Tests, Department of Public Works, County of Allegheny, have approved the material, requiring only that 45 minutes shall be the time limit between manufacture and deposit in forms. As an example, the largest bridge in the Pittsburgh district, the Liberty bridge, used 28,000 cu.yd.

The following architectural and engineering firms have approved and permitted the use of this material in building construction: Graham, Anderson, Probst & White, Chicago, Ill., 36-story Koppers Building, more than 20,000 cu.yd.; Rust Engineering Company and Mellon-Stuart Company, contractors. Thompson-Starrett Company, New York, and Henry Hornbostel, engineers and architects, respectively, caissons for new 36-story Grant Building. F. T. Ley, New York, on recently completed Plaza Building, foundations and floors. Weber &

Wurster, Philadelphia, on recently completed Roosevelt Hotel, foundations and floors. John M. Donn, Washington, D. C., architect, Cathedral Mansions, a twelve-story reinforced-concrete structure. Albert Kahn, Inc., Detroit, Mich., New Packard Building, foundations and floors.

One of the most important building jobs in the city of Pittsburgh last year was the construction of two additional sub-basements beneath the Kaufman & Baer department store, which was carried out in gravel formation below river level. The specifications called for 2,000 lb. concrete in three days. Cylinder breaks showed an average of 2,000 lb. in one day. Ready-mixed concrete was used throughout.

There is hardly a steel mill or other industrial establishment in the Pittsburgh district that has not at some time or other used ready-mixed concrete for engine foundations or similar purposes. Concrete for these mills is generally delivered in 1½-yd. buckets loaded on ordinary trucks. At the mills the buckets are picked up by a traveling crane and taken to the point of use. During the past three years the Jones & Laughlin Steel Corporation has used thousands of yards in the modernizing of its Pittsburgh mills.

A large business has been built up on small orders. Small home owners have become accustomed to purchasing a few yards of concrete for needed improvements and thus, by placing it themselves, save much money as well as being assured of an honest mix.

*Conclusions*—1. After three years' experience in selling the idea of ready-mixed concrete in a city the size of Pittsburgh and knowing in a general way the development of this new business in other cities, the writer feels that it will be but a short time until ready-mixed concrete not only will be used by contractors on every possible occasion but will be specified by architects and engineers.

2. This evolution (the change from transporting raw materials, sand, gravel and cement to transporting finished concrete) will be more far-reaching in its results than those who will be affected realize. The manufacturer of ready-mixed concrete is a new middleman for the producer of sand, gravel, stone, slag or cement to reckon with. The retailer of building materials and supplies will no longer be the outlet for the producer of concrete aggregates and cement. And mark this, the manufacturer of ready-mixed concrete is limited in the number of kinds of cement he may use and similarly in the number of sand, gravel, slag or stone producer's products he may use.

It may mean that the day is at hand when the producers of these materials entering into the composition of concrete may have to become, in sheer defense, manufacturers of ready-mixed concrete, or at least will have to control the ready-mixed concrete companies, just as recently many of the large steel mills have been compelled to purchase control of concerns engaged in retailing steel products.

3. The central mixing plant offers a medium through which all of the inaccurate and uncontrolled proportioning methods that cannot be escaped in field work can be eliminated and the manufacture of concrete placed upon as scientific a basis as the making of fine steels. And when the concrete engineer commences to think of concrete manufacture in terms of "factory" production rather than as a field operation with such limited means as are afforded in a portable mixing plant, it will not be long until the whole process will be revolutionized.

4. There are several types of special bodies on the market designed specifically to carry ready-mixed concrete. Several of these are known as agitator bodies, wherein, to overcome segregation and sticking, the concrete is constantly turned over by mechanical means while being transported to the job. On one of these a separate motor furnishes means for agitation. The others take power from the truck motor through a separate take-off. Aside from possible mechanical difficulties which might arise, one objection to these bodies that has been encountered in the larger cities is that the officials of the building trades unions demand that apprentice engineers be placed on trucks of this character, thus greatly increasing the cost of delivery and in some cases making it uneconomical.

After all, aside from the refinements made possible in the manufacture of concrete through the adoption of factory methods, the main factor upon which success or failure rests is transportation. If means can be found whereby this department can be efficiently and economically operated there will be no question as to the outcome.

Concrete must be furnished in a workable condition. This cannot be done with ordinary dump trucks. Concrete must be furnished as required and when wanted. Sand, gravel and cement can be delivered days before required. Ready-mixed concrete must be delivered when the contractor wants it. This means that an efficient, economical transportation system with extra units ready at all times to take care of peak loads is a prime necessity.

## Test on Walls of Interlocking Tiles

Eight walls, 12 in. thick, 6 ft. long, and 9 ft. high, built of shale tile of a new design having interlocking ribs, have been tested by the Bureau of Standards in cooperation with the Research Service, Inc., Washington, D. C. Four walls were tested in compression, three walls under transverse loading, and one wall was subjected to a transverse load before being tested in compression. Lime, cement-lime, cement, and no mortars were used in the horizontal joints. In order to obtain a continuous bond throughout the height of the wall the horizontal joints were broken by the use of half tile. The results of the tests lead to the following conclusions: (1) The results of the transverse tests indicated the resistance of the walls to side pressure was affected by the conditions and nature of the cementing material. The wall with no mortar in the horizontal joints took a maximum thrust of 5,350 lb., or about 25 per cent greater load than that sustained by the wall with lime mortar beds—namely, 4,200 lb. The highest maximum thrust, 10,800 lb., was sustained by the wall with the cement lime-mortar joints. This latter case gave an equivalent uniform wall load of 270 lb. per sq.ft. of wall surface, and a "modulus" of rupture of 102 lb. per sq.in., which was higher than any other tile wall so far tested at the bureau; (2) the compression strength of the walls seemed to be directly dependent upon the workmanship and mortar used in the horizontal joints. The wall with no mortar beds had a compressive strength of 310 lb. per sq.in. gross area, the wall having cement lime beds developed a compressive strength of 1,270 lb. per sq.in., while the two walls with cement mortar beds give an average compressive strength of 880 lb. per sq.in. A report of these tests has been published by the Bureau of Standards in Technologic Paper No. 366.

# Beam Tests of Pavement Concrete Placed by Two Methods

## Slabs Cut From Pavement Laid Under Identical Conditions Show Slightly Superior Strength of Standard Concrete

By Thomas R. Beeman
*Seattle, Wash., Formerly County Engineer, King County, Washington*

DURING the last two years that the writer was county engineer of King County, Washington, he was urged to include in his specifications a pavement made of a leaner concrete than the normal mix and compacted by vibrating machines, which latter treatment was claimed to equalize the reduction in cement and to densify and compact the concrete, making a pavement stronger and superior to the standard King County pavement of 1:2:3 mix (1.67 bbl. cement per cubic yard).

In the spring of 1926 a contract was let for paving the north, or county, side of North 85th St., whose center line forms the north boundary of Seattle. The contract was awarded for the standard 1:2:3 mix of concrete, of 7 in. uniform thickness, to J. L. Smith, an able and experienced contractor. Early in June, 1926, permission was granted by the county commissioners to lay for demonstration purposes two blocks of this pavement, from Ninth Ave. N.W. to Eleventh Ave. N.W., by the special method referred to. This section was to be of 1:2:4½ mix (1.30 bbl. cement per cubic yard), and was to be placed in accordance with printed specifications of the American Vibrolithic Corporation of America for "compressed concrete placed by the vibrolithic method." Attention is directed to the fact that this was not the standard "vibrolithic" pavement as laid by the above-named corporation, but differed in the fact that no crushed rock was forced into the concrete by the vibrating machines.

The laying of the two blocks of demonstration pavement, which was done under the supervision of representatives of the patentee, was entirely satisfactory in showing the method of placement, the bringing of mortar to the surface, the bubbling of escaping air and the tremor imported to the near-by ground by the mechanical placement. It could not, of course, show that the resulting pavement was superior to or inferior to the standard pavement in the adjacent blocks. Time undoubtedly would tell the story, but time speaks slowly. Consequently the decision was reached to cut test slabs from both the compacted and the standard pavements and to test them in a manner as nearly comparable to the 1926 Bureau of Public Roads tests (see *Engineering News-Record*, May 13, 1926, p. 779) as conditions would permit. Assuming the possibilities of securing undamaged test specimens, there were many reasons for making the test. The interior structure of the two concretes would be revealed on the cut surfaces; the comparative carrying capacities could be determined by testing the slabs as beams, and, what was most important, an opinion of the respective values of the two types of pavement could be formed based on actual field conditions, which were identical for both types, since the contractor, crew, inspector, mixer, cement, aggregate, subgrade, curing, weather and age at cutting out and testing were or could be made the same, and the only variables were the cement content and the method of placement. Moreover, at the time these pavements were laid there was no thought of test slabs being cut from them and variations for that cause could likewise be eliminated; both were strictly commercial products, the standard pavement being placed with a 1 to 2 in. slump and the compacted with about the same, three tests all measuring 1½ in.

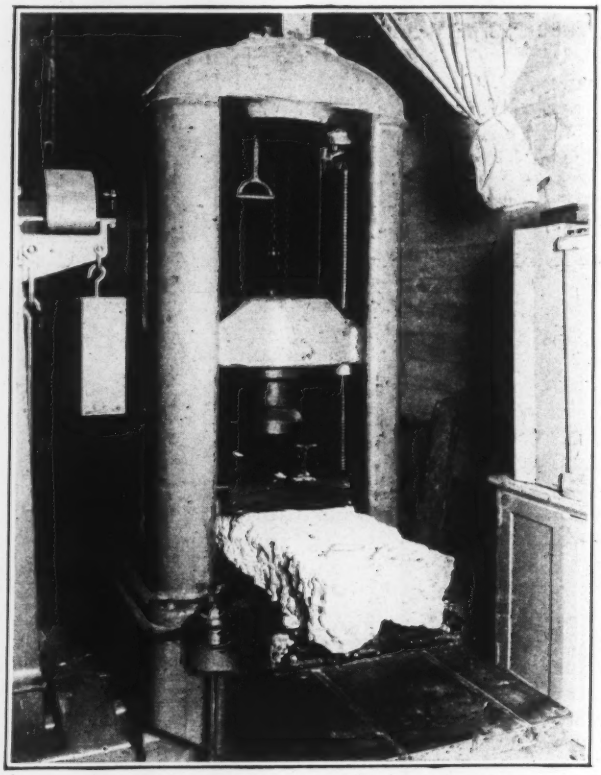

FIG. 1—SPECIMEN SLAB IN TESTING MACHINE

The co-operation of the engineering department of

TABLE I—RESULTS OF TESTS OF SLABS OF STANDARD 1 : 2 : 3 CONCRETE

| Slab No. | $\frac{I}{c}$ Top | $\frac{I}{c}$ Bottom | $I$ | $\frac{I}{c}$ Top | $\frac{I}{c}$ Bottom | Tension Side | Applied Load, Lb. Bottom | Applied Load, Lb. Top | Moment In.-Lb. 6,000 In.-Lb. | Modulus of Rupture Bottom | Modulus of Rupture Top | Age When Tested |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.55 | 3.65 | 524.12 | 147.64 | 143.59 | Bottom | 7,720 | ..... | 83,200 | 579 | ... | 28 |
| 2 | 3.55 | 3.95 | 499.80 | 140.79 | 126.53 | Top | ..... | 7,030 | 76,300 | ... | 542 | .. |
| 3 | 3.79 | 4.01 | 578.70 | 152.69 | 144.31 | Top | ..... | 7,520 | 81,200 | ... | 530 | .. |
| 4 | 3.68 | 4.02 | 578.40 | 157.17 | 143.88 | Bottom | 8,460 | ..... | 90,600 | 629 | ... | .. |
| 5 | 3.65 | 3.95 | 548.48 | 150.27 | 138.86 | Bottom | 7,050 | ..... | 76,500 | 551 | ... | 32 |
| 6 | 3.58 | 4.02 | 531.16 | 148.37 | 132.13 | Top | ..... | 7,940 | 85,400 | ... | 575 | .. |
| 7 | 3.60 | 4.10 | 507.71 | 141.03 | 123.83 | Top | ..... | 6,690 | 72,900 | ... | 517 | .. |
| 8 | 3.67 | 3.83 | 513.67 | 139.96 | 134.12 | Bottom | 7,170 | ..... | 77,700 | 579 | ... | .. |
| 9 | 3.70 | 4.10 | 562.97 | 152.15 | 137.31 | Top | ..... | 7,680 | 82,800 | ... | 544 | 34 |
| 10 | 3.39 | 4.21 | 459.49 | 135.54 | 109.17 | Top | ..... | 6,640 | 72,400 | ... | 534 | .. |
| 11 | 3.63 | 4.27 | 565.35 | 155.74 | 132.71 | Bottom | 7,180 | ..... | 77,800 | 586 | ... | .. |
| 12 | 3.65 | 3.95 | 518.52 | 142.06 | 131.27 | Bottom | 7,620 | ..... | 82,200 | 626 | ... | .. |

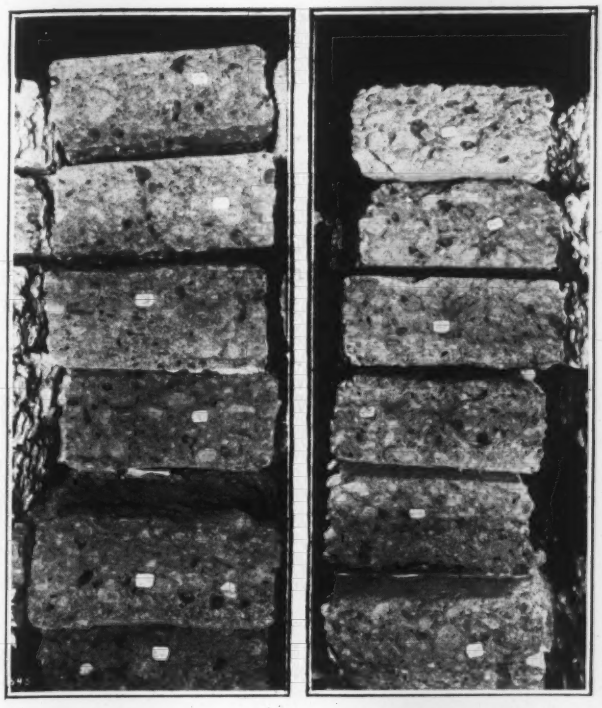

FIG. 2—TYPICAL FRACTURES OF STANDARD (LEFT) AND VIBRATED (RIGHT) SLABS

the city of Seattle was obtained, and it was arranged to have the slabs tested in the city testing laboratory, which is equipped with a large Riehle machine. This machine's clearance established a slab breadth of 18 in. and it was decided to cut out twelve slabs of each kind of pavement, 6 ft. long, half to be tested in normal position and half inverted.

When the pavements were twenty days old, they had had ten days of water curing and ten days in air. At this age an air compressor and jackhammer drills were taken to the job, and with a crew of three men the slabs were cut from the pavement. We knew of no precedent to guide us in this matter, but believed that by putting down a line of holes on the margins of the slabs they could be wedged off. Random panels were selected of each type of pavement from which the test slabs were cut, the only criterion being that the inspector's record showed them to contain the specified and required amount of cement.

The first slabs cut out were of the patented type, and of these the first four were obtained by drilling the marginal holes 2 or 3 in. on centers and completely through the slab. Almost continuous spalling along the bottom edges resulted with these specimens, due partly no doubt to the gravelly character of the bottom of these slabs, but principally to the hammering of the drills as they approached the bottom. Consequently the method was thereupon radically changed. The drill holes were spaced 6 in. on centers and were carried down 3½ in., or to the middle of the pavement. Feathers and wedges were then placed in all the holes and the wedges were tightened and tapped successively with a drill hammer until a sudden straight crack appeared along the line of the drill holes.

This method of cutting out test slabs proved simple and efficacious and gave slabs of as true rectangular section as could be expected. At the testing laboratory a stone mason dressed up the side irregularities. At the age of 28 days the first four slabs were tested; the tests were continued, four per day, until the run was completed. The specimens were tested on a 60-in. span with third-point loading. I-beams formed the supports and the medium of applying third-point loads, being seated and bedded in a mixture of plaster of paris and sand.

Tables I and II contain the test results. The specimens of course varied in breadth and depth and were more or less irregular. They were carefully calipered on the planes of fracture and the $I/c$ values were computed from these measurements. From the tables the following summary can be made:

1. With tension on the bottom, the standard specimens carried an average applied load 15 per cent greater than that carried by the compacted.

2. With tension on the bottom, the standard specimens showed a modulus of rupture 4.6 per cent greater than that shown by the compacted.

3. With tension at the top, the standard specimens carried an average applied load 12.1 per cent greater than that shown by the compacted.

4. With tension at the top, the standard specimens showed a modulus of rupture 2.6 per cent greater than that shown by the compacted.

5. The great variation in the moduli of rupture of the compacted specimens, in contrast to the standard specimens, is pronounced. Some specimens were very high and others were very low.

The standard specimens showed a very uniform structure both top and bottom. The compacted slabs showed very excellent structure and excellent density in the top half of the slab, but poor structure in the bottom half. Both standard and compacted slabs showed a higher modulus of rupture with tension on the bottom of the slab than with tension on the top.

The fact that the moduli of rupture were in much closer agreement than the applied loads is due to the fact that the standard slabs slightly exceeded the specified 7-in. thickness, whereas the compacted did not.

TABLE II—RESULTS OF TESTS OF SLABS OF COMPACTED 1 : 2 : 4½ CONCRETE

| Slab No. | $c$ Top | $c$ Bottom | $I$ | $\frac{I}{c}$ Top | $\frac{I}{c}$ Bottom | Tension Side | Applied Load, Lb. Bottom | Applied Load, Lb. Top | Moment, In.-Lb. 6,000 In.-Lb. | Modulus of Rupture Bottom | Modulus of Rupture Top | Age When Tested |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.50 | 3.60 | 476.03 | 136.01 | 132.23 | Bottom | 8,320 | ..... | 89,200 | 675 | ... | 28 |
| 2 | 3.72 | 3.98 | 557.20 | 149.78 | 140.00 | Bottom | 7,040 | ..... | 76,400 | 546 | ... | .. |
| 3 | 3.49 | 3.71 | 426.95 | 122.34 | 115.08 | Top | ..... | 7,320 | 79,200 | ... | 648 | .. |
| 4 | 3.66 | 3.94 | 533.20 | 145.68 | 135.33 | Top | ..... | 6,820 | 74,200 | ... | 509 | .. |
| 5 | 3.60 | 3.70 | 477.58 | 132.66 | 129.08 | Bottom | 5,680 | ..... | 62,800 | 487 | ... | 32 |
| 6 | 3.55 | 3.75 | 509.23 | 143.45 | 135.79 | Bottom | 5,590 | ..... | 61,900 | 456 | ... | .. |
| 7 | 3.66 | 4.34 | 557.35 | 152.28 | 128.42 | Top | ..... | 5,840 | 64,400 | ... | 423 | .. |
| 8 | 3.50 | 3.80 | 462.12 | 132.03 | 121.61 | Top | ..... | 6,020 | 66,200 | ... | 501 | .. |
| 9 | 3.26 | 3.94 | 400.16 | 122.75 | 101.56 | Top | ..... | 6,870* | 72,700 | ... | 592 | .. |
| 10 | 3.44 | 3.76 | 460.99 | 134.01 | 122.60 | Top | ..... | 5,920 | 65,200 | ... | 486 | 34 |
| 11 | 3.27 | 3.73 | 392.75 | 120.10 | 105.29 | Bottom | 5,640 | ..... | 62,400 | 593 | ... | .. |
| 12 | 3.38 | 3.62 | 429.14 | 126.96 | 118.55 | Bottom | 7,010 | ..... | 76,100 | 642 | ... | .. |

* Tested on 40-in. span. Center line load add 4,000 in.-lb.

Items 1, 3 and 5 are, of course, the facts of primary importance to King County or to any other purchaser of pavements. Items 2 and 4 are of secondary interest, since the respective moduli of rupture may or may not be of value. A higher modulus, with less thickness, is of no consequence. The fact that a higher modulus of rupture was developed with tension on the bottom of the slabs than with tension on the top is at variance with general experience, but illustrates the effect of difference in curing; the top of the pavements had been water-cured for ten days and then exposed to the hot summer sun for ten days before the slabs were taken out, whereas for the same twenty days the bottom of the slabs had been in contact with the moist subgrade.

Fig. 1 shows a specimen in the testing machine; Fig. 2 shows a close-up view of typical fractures of standard and compacted specimens. The specimens were cut out and tested under the supervision of Peter Mogenson, for King County, and thanks are particularly due to H. F. Faulkner, city testing engineer, Seattle, for a great deal of laborious and careful work in making these tests.

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A proof of the above article was furnished to the American Vibrolithic Corporation for comment. The reply follows:

We are grateful for the opportunity of reviewing the article by Thomas R. Beeman on certain tests on so-called "vibrated concrete" as made in King County, Washington, in June, 1926.

As clearly stated in Mr. Beeman's article, these tests cannot be considered as a test of standard vibrolithic construction, as the elimination of the surfacing stone constituted a radical departure from usual vibrolithic practice. It was understood in advance that the demonstration was experimental in nature and that the specifications were tentative in character. This method of construction was not being commercially marketed at that time.

The test beams were all cut from one large slab of each concrete. This means that all the concrete tested came from a very few batches of concrete and was only a very small portion of the concrete placed during a single day. Since apparently there was no attempt made to keep more than a casual check on the whole job, there is nothing to indicate whether the particular spot selected at random for the removal of the test slabs gave a representative sample of either concrete.

Nothwithstanding the new and experimental nature of the "compressed" construction, the average modulus of rupture of the vibrated concrete is practically equal to the average modulus of rupture of the ordinary concrete, in spite of the fact that the ordinary concrete contained 34 per cent more cement. It is hardly possible to follow this article in dismissing the modulus of rupture as being of no great significance. If this is true, the quite universally recognized edge depth is wrong, and practically all of the state highway departments are wrong in basing their standard slab design largely upon this formula.

The control of the construction was so uncertain, the characteristics of the slabs actually tested so unknown and the scope of the test so limited that further comments on this test seem unnecessary.

The results of this demonstration and subsequent experiments and developments showed that an extensive redesign of equipment and different construction technique were necessary to compensate for the elimination of the surfacing stone used in standard vibrolithic construction. The improved platforms and the later developed technique now used in building vibrolithic method "compressed" concrete slabs insure full-depth compaction of the slab, even where surfacing stone is not used.

The most comprehensive and best regulated tests of vibrolithic method concrete compared with ordinary concrete ever made were those made by the U. S. Bureau of Public Roads in 1926 and 1927. The bureau made 80 slabs of each kind of concrete, each slab of known characteristics, and built and tested according to the most modern practice, half at age of 28 days and half at the age of one year. These tests show conclusively that standard stone-covered vibrolithic method concrete has very much higher tensile strengths and is equal or superior in every other physical characteristic to ordinary concrete of richer mixtures. These tests are published in full by the Bureau of Public Roads in its official organ *Public Roads* in the issues of April, 1926, and October, 1927.

Washington, D. C.

A. R. HIRST,
Chief Engineer,
American Vibrolithic Corporation.

## Soil Corrosion Data Sought by Goverment

The U. S. Bureau of Standards has issued a preliminary report of progress made on tests of about 14,000 specimens of pipe materials, fittings, and protective coatings, which have been buried in 47 different soils in an effort to determine the relation of soils to the corrosion of buried pipe. Preliminary conclusions in the report are based on the examination of about 2,000 of the tested materials, which are removed from time to time for examination. The end of the test will not come until 1932, ten years from its commencement, at which time a final report will be made of the findings of the bureau.

So far no one commonly used ferrous pipe material has been found superior to all others under all conditions. The same conclusion may be applied to non-ferrous materials, for some that are satisfactory in certain soils do not do so well in others. In acid clay soils, galvanized steel appears to last longer than ungalvanized, but in some strong alkali soils zinc is attacked rapidly. Corrosion of cast iron has been observed in locations where stray electric currents were not present, and it is not possible to distinguish between electrolysis and soil corrosion by the appearance of the pipe. Very little serious pitting of copper and brass specimens has been observed.

The factors which influence soil corrosion are not fully understood, nor is there any satisfactory laboratory methods of determining the corrosive qualities of a soil. It is hoped that the present series of tests will be of aid in developing such methods.

## Canadian Boundary Well Marked

The marking of the boundary lines between Canada and the United States and between Canada and Alaska is the present work of the International Boundary Commission. The total length of the two lines is 5,526 miles, all of which has been thoroughly surveyed and marked by 5,460 line monuments and 2,521 reference monuments. An exact description of the boundaries includes a total of 10,310 straight-line courses, of which the largest is 647 miles. This is believed to be the longest straight-line course in any survey in the world.

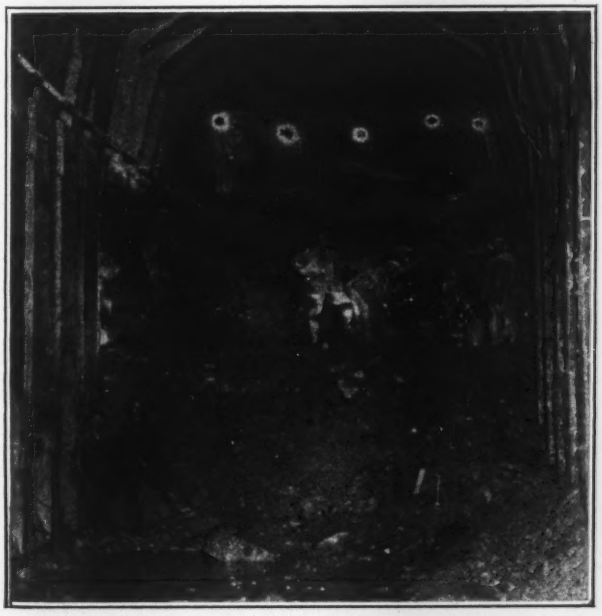
# Driving a ½-Mile Rock Tunnel on the Illinois Central R.R.

## Three Different Heading Plans Used—Shale Strata Necessitated Close Timbering—Power Mucking Employed

THE new 166-mile line of the Illinois Central Railroad from Edgewood, Ill., to Fulton, Ky. (Illinois & Kentucky Railroad), which was completed in June, 1928, included three rock tunnels 800 ft., 6,900 ft. and 2,625 ft. long and 18x26 ft. in section, with vertical sides and semicircular roofs. The construction of the longest tunnel was described in *Engineering News-Record*, March 4, 1926, p. 370. Tunnel No. 3, 2,625 ft. long, in sandstone strata separated by soapstone shale, is described here because three methods of driving were employed.

For the first 375 ft. from the south portal, with troublesome material, wall-plate headings were driven. For the next 1,588 ft. the top heading was taken out for the full width of the arch. For the remaining 645 ft. a center heading 8x10 ft. was taken out, with its bottom at the same grade as that of the previous top heading. This last method was employed chiefly as a quick means of providing natural ventilation. The tunnel was driven from the south end only, except for about 100 ft. of the 8x10-ft. heading at the north end. In the wide top heading method used for the greater distance, the height was 12 ft., while the bench was taken out in two 8-ft. lifts.

Driving and mucking were carried on simultaneously in heading and bench. In the heading, the top holes were drilled by men standing on the muck pile; the lower holes were drilled after mucking. Muck in the heading was loaded by a compressed-air mucker into 1¼-yd. cars hauled by mules to the south portal, where they were dumped into 4-yd. cars, which were hauled to the fill by small gasoline locomotives. The bench was mucked by a ¾-yd. power shovel operated by compressed air. The arrangement of drill holes in heading and bench was changed frequently owing to changes in the character of rock encountered. Electric lighting and air-compressing plants were operated by oil engines.



HEADING AND BENCH, SHOWING TIMBER LINING OF ILLINOIS CENTRAL TUNNEL

The lining consists of sills, posts and wall plates supporting five-segment roof arches. It was put in by a separate crew. The timbers were cut to size at a framing shed near the south portal and were hauled by narrow-gage cars into the tunnel, where they were stacked at convenient places, from which they were taken as required by the timbering crew. Concrete is used only for the portals, with about 15 ft. of concrete lining to anchor the portal to the rock.

Two ten-hour shifts were worked, with an average of twenty men per shift. Progress in the wide heading averaged 5.65 ft. per day and 176 ft. per month, with a maximum of 271 ft. per month. In driving the 8x10-ft. heading, the maximum progress was 42 ft. per day and 525 ft. in one month. Progress on the bench averaged 11.02 ft. per day and 317 ft. per month, with a maximum of 24 ft. and 413 ft., respectively.

On the 3¼-mile section including the tunnel, the contractors were R. S. Morrow & Son, of Omaha, Neb. For the railroad, T. H. Robertson was assistant engineer, and P. R. Henderson resident engineer. All the work on the 166-mile line was under the direction of A. F. Blaess, chief engineer, and E. L. Crugar, engineer of construction, Illinois Central Railroad.

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## Reconstruction of Earthquake-Damaged Japan Is Rapid

Reconstruction of the earthquake-damaged cities of Tokyo and Yokohama has proceeded with remarkable rapidity since the catastrophe of Sept. 1, 1923, according to a report to the Department of Commerce from Assistant Commercial Attaché J. H. Ehlers, Tokyo. In September, 1927, four years after the earthquake, it was estimated that more than 60 per cent of the total project for reconstructing Tokyo and more than 70 per cent of the program for recreating the city of Yokohama had been completed. The estimated expenditure for reconstruction purposes to the middle of 1927 had reached a total of about $612,000,000.

The earthquake did much damage to the bridges of the two cities. Of the 583 bridges in Tokyo in 1922, 69 were shaken down by earthquake shocks and 289 destroyed by fire. As a result of the lessons learned through the calamity, the bridge-building program was realized to be a vital part of the reconstruction work and essential to any system providing safety in future emergencies of a similar nature. The program being carried out by the Reconstruction Bureau includes 97 main bridges and 21 bridges over canals, besides 308 bridges to be constructed by the city of Tokyo. In the construction of these bridges some American equipment is being used. An American locomotive crane was used on one structure; compressors and pneumatic riveters are almost entirely of American make; about 80 per cent of the concrete mixers are also of American make.

Other important parts of the vast reconstruction program of these two Japanese cities include the construction of subway systems and of modern sewers, canals, allocation of parks, provision for schools, hospitals, markets, water-works, electrical stations and power houses, and a zoning system, all along the most approved modern lines.

# New Pumping and Filtration Plant for Knoxville Water-Works

## River Intake of Perforated Steel Pipes—Generators on Shaft of Steam-Turbo Centrifugal Pumps Generate Current to Operate Low-Lift Pumps

By Charles B. Burdick
Alvord, Burdick & Howson, Engineers, Chicago

A Combination of steam and electric drive in the new pumping plant for the water-works of Knoxville, Tenn., was adopted as a convenient and economic arrangement. Steam turbines drive centrifugal high-lift pumps, whose shafts carry electric generators supplying current to the motors driving the low-lift pumps, which also are of the centrifugal type.

—Editor.

With the completion of its new Williams Creek pumping station and filtration plant, the city of Knoxville, Tenn., is assured of an adequate supply of pure and clean water. While the Tennessee River continues to be the source of supply, the new plant takes the water at a more available place immediately above the city and occupies a new site adequate for enlargement to meet future needs. The building which houses the pumps and filters is shown in Fig. 1, while Fig. 2 shows the general layout of the plant. Within the past two or three decades Knoxville has assumed increasing importance as an industrial center, largely due to the marble industry. Its population reached 36,000 in 1910, 77,000 in 1920 and is now estimated at about 100,000. Annexation of adjoining suburban towns has contributed to this growth. The average daily water consumption has increased from 7 m.g.d. in 1916 to 9 m.g.d. at present. This comparatively moderate increase in the face of rapid growth of population has been due largely to the fact that all consumers have been metered since 1917.

The new plant is on the north bank of the Tennessee River in the southeasterly part of the city, just above the mouth of Williams Creek. The site is protected against eastward expansion of the city by the bluffs or hills in which are the marble quarries and which closely border the south bank nearly to the junction of the Holston and French Broad rivers. These streams join 3 miles above Williams Creek to form the Tennessee River. The plant displaces an old pumping station on the water-front and an old filter plant on Filter Plant Hill, in the central part of the city. This latter was one of the early mechanical filter plants and furnished a satisfactory water supply until its capacity was outgrown.

The limitation of the old site for expansion and the desirability of consolidating pumping and filtering operations led to the construction of the new plant, the layout of which is controlled by conditions of irregular topography, protection against high water, accessibility of the railroad and provision for accommodating the runoff of Williams Creek, which crosses the property. The desirability of centering the operations of steam generation, high-lift pumping, low-lift pumping and filtration dictated the arrangement of the structures shown in Fig. 2. Availability of ground at a suitable elevation made it desirable to locate the coagulation basins on the opposite side of the creek about 300 ft. from the filters.

*Water and Intake*—The river water here is subject to rapid changes in character, dependent upon the

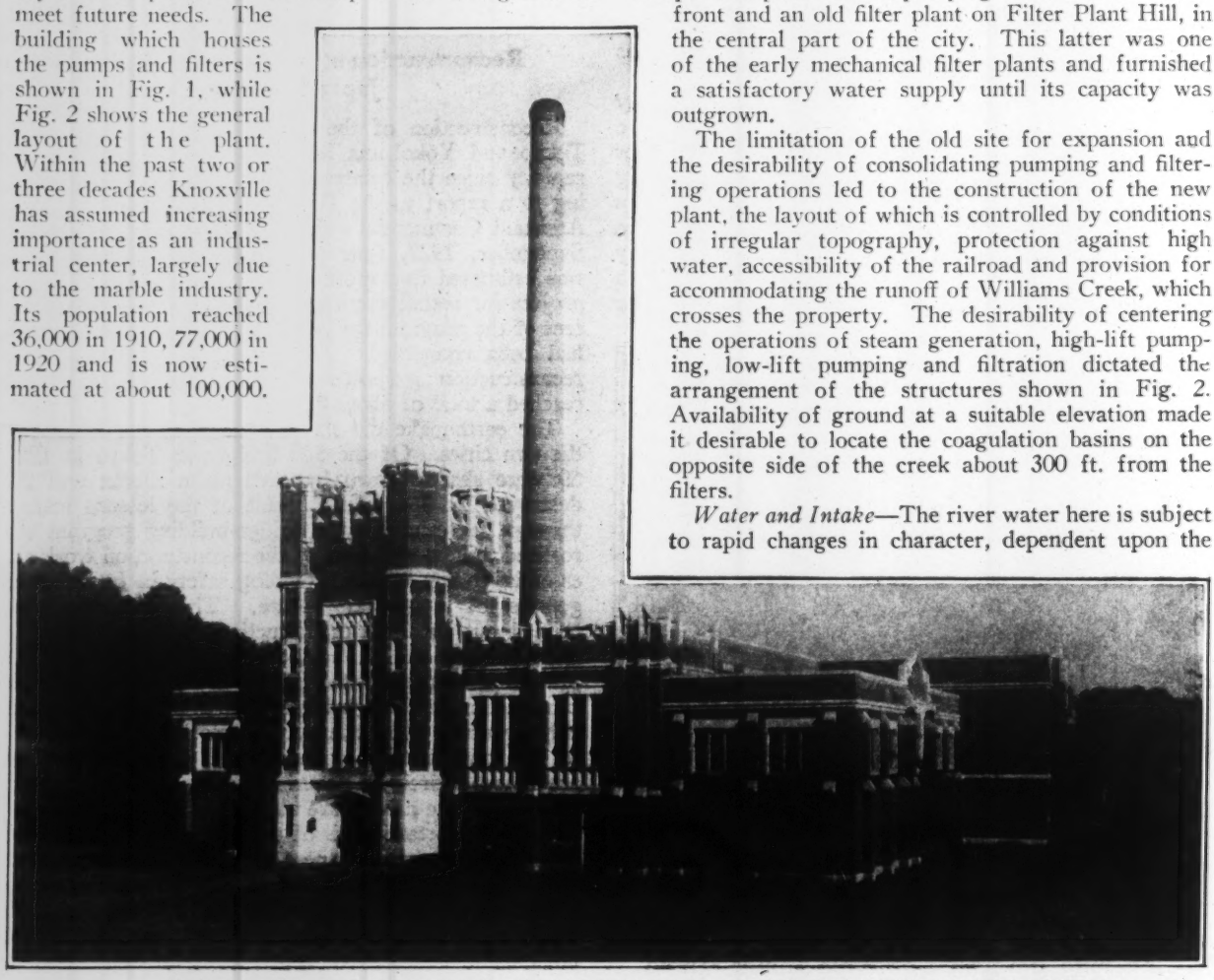


FIG. 1—WILLIAMS CREEK PUMPING AND PURIFICATION PLANT, KNOXVILLE WATER-WORKS

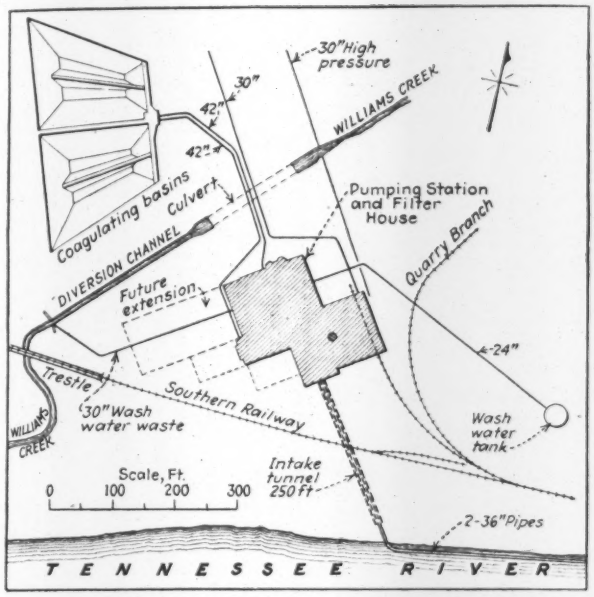



FIG. 2—LAYOUT OF NEW WATER-SUPPLY WORKS

predominance of the two large tributaries mentioned. The water of the French Broad River is comparatively soft; it carries considerable colloidal clay and some color caused by industrial wastes, most of which are organic. The Holston River water is harder, with less turbidity, and its industrial wastes are largely inorganic. The water reaching the plant is subject to high turbidity in floods. All surface drainage and sewage of Knoxville reaches the river below the Williams Creek plant, and on account of the local topography it doubtless will continue to be thus discharged.

At the plant the river is wide and shallow, with a sand and gravel bottom more or less unstable in character, depending upon the river flow. About 700 ft. upstream the current strikes the north bank and has washed the bottom to bedrock with a strong current and a low-water depth of 10 to 15 ft. within 80 ft. of shore. This furnished the most satisfactory location for the intake, which consists of two lines of 36-in. pipe, having the outer ends supported upon piers built of precast reinforced-concrete blocks as large as could be handled conveniently by a floating derrick. These piers rest on bedrock, to which both pipes and piers are anchored. The intake construction is shown in Fig. 3.

Water enters the pipes through 1-in. holes spaced 2 in. c. to c. in the outer three lengths of pipe in each intake line. The ends of the pipes are closed with perforated plates. These perforations form a screen to prevent the ingress of substances sufficiently large to interfere with the pumps. They are sufficient in number and area to produce a velocity of 5 in. per second when furnishing water at a 30-m.g.d. rate through both intake pipes. The present plant produces only one-half this velocity. Pipe connections permit water from the coagulating basins to be back-flushed through the intake to rid the screens of leaves or other floating substances adhering to the outside. These screen sections of the intakes are of ½-in. steel plate, with punched holes, while the remainder is of cast-iron pipe. The two intake lines follow the low-water edge below the low-water plane to the mouth of the intake tunnel, into which they rise to a plane 8 ft. above the water and thence pass through the intake tunnel beneath the Southern Railway tracks to the low-lift pump pit, a distance of 250 ft. This tunnel is open to the river, its purpose being merely to provide access to the pipes for repair, as otherwise they would be buried in a 30-ft. trench.

*Low-Lift Pump Pit*—This pit (see Fig. 5), 38 ft. in diameter and 22 ft. deep, is designed to accommodate three 18-m.g.d. horizontal electrically driven centrifugal

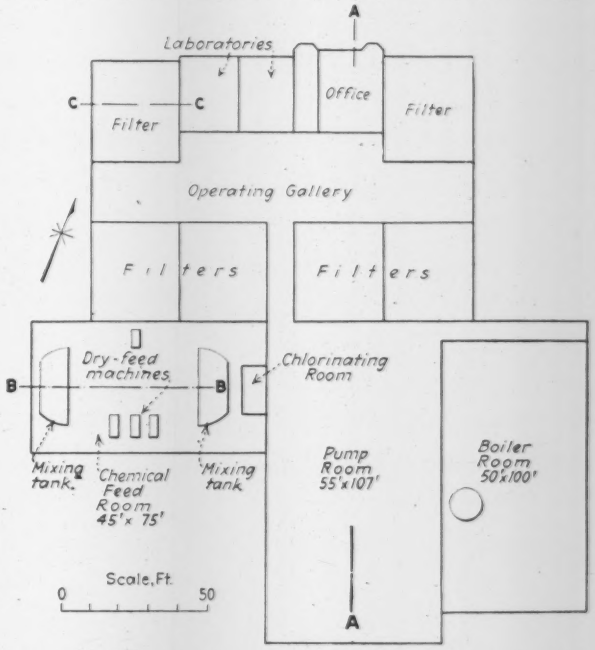



FIG. 4—GENERAL PLAN OF PUMP AND FILTER STATION

pumps. Larger pumps could be accommodated in the space provided. It is a dry pit, reinforced to withstand pressures in extreme high water. As the building is founded on top of the pit, its weight counteracts upward pressure. The two 36-in. intake pipes enter the pit through a watertight joint.

*Mixing Chambers*—The low-lift pumps deliver water to two mixing chambers, each of which is a circular tank containing ten minutes' supply at rated plant capacity. These tanks can be operated either in parallel or in series and are equipped with mechanical stirring apparatus capable of producing rotative velocities at will up to a peripheral velocity of 2 ft. per second. Each agitator is driven by a 3-hp. motor. Water is admitted tangentially at the top and is taken off at the center on the bottom of each tank. Thus the ten-

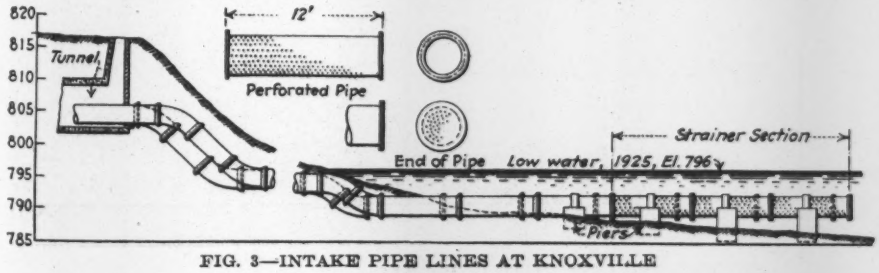



FIG. 3—INTAKE PIPE LINES AT KNOXVILLE

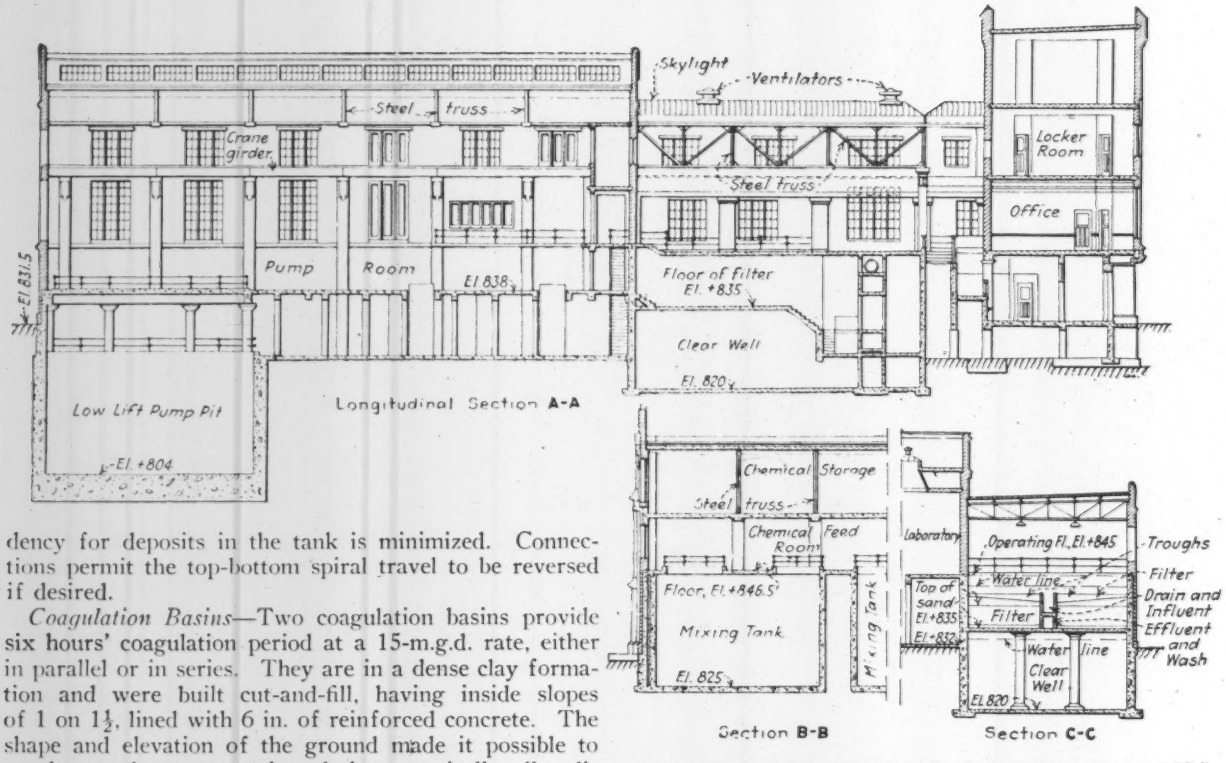



FIG. 5—SECTIONS THROUGH PUMP ROOMS AND FILTERS

dency for deposits in the tank is minimized. Connections permit the top-bottom spiral travel to be reversed if desired.

*Coagulation Basins*—Two coagulation basins provide six hours' coagulation period at a 15-m.g.d. rate, either in parallel or in series. They are in a dense clay formation and were built cut-and-fill, having inside slopes of 1 on 1½, lined with 6 in. of reinforced concrete. The shape and elevation of the ground made it possible to use hopper bottoms so shaped that practically all sediment can be discharged by gravity through 12-in. cast-iron pipes without emptying the basins. Eight outlet valves in each basin are controlled by hand, using extension stems accessible from a central walkway. Water is distributed uniformly across the west or wide end of each basin by means of wooden baffles slotted vertically at 6-in. intervals to secure uniform cross-sectional delivery at very small head loss. Settled water is drawn over surface weirs at the east or narrow end of the basins, thence passing to the filters. The supply and return pipes are 42 in. in diameter.

*Filter Plant*—Six 2.5-m.g.d. filters are arranged on two sides of a pipe gallery over a clearwater reservoir in the basement (Figs. 4 and 5), each filter discharging into the basin through a controller. The basin is divided into two compartments. A double-barrel conduit controlled by gates leads into a double suction well under the pump room from which the high-lift pumps draw their supply. As this station is designed to operate in conjunction with a capacious elevated reservoir, only a nominal capacity of 0.84 m.g. is provided in the clear-well. Fig. 6 shows the filters and operating gallery.

Three dry-feed machines are provided. Alum and occasionally lime are used at present. Chemicals are wheeled from cars on a hand truck, taken to the second floor in an elevator and stored at the level of the feed hoppers to the machines which are located upon the floor

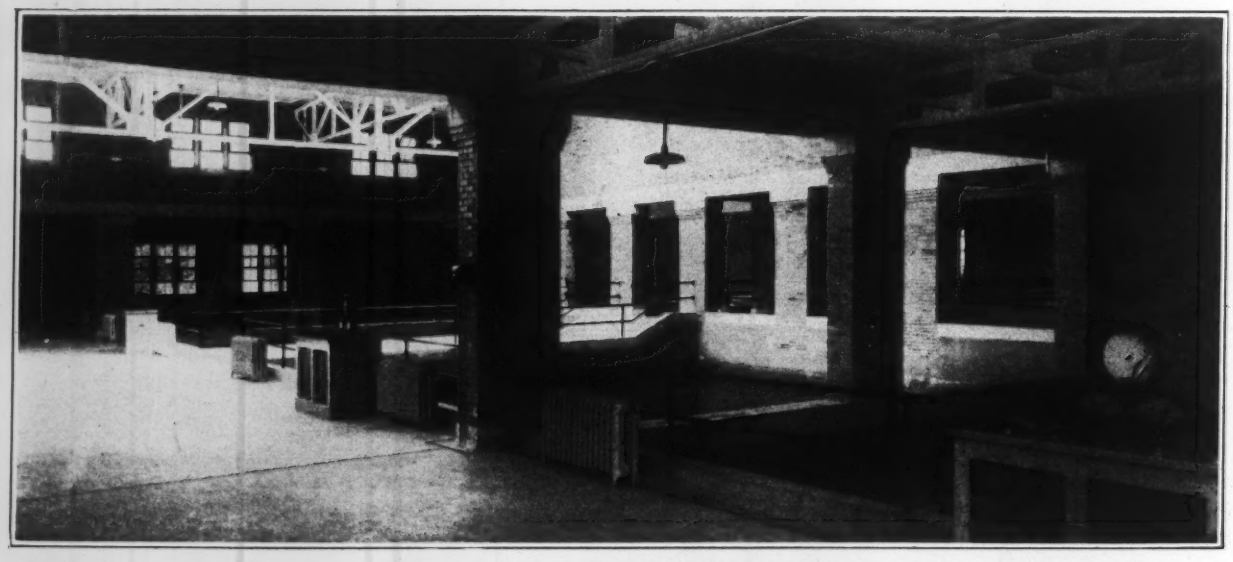


FIG. 6—FILTERS AND OPERATING GALLERY

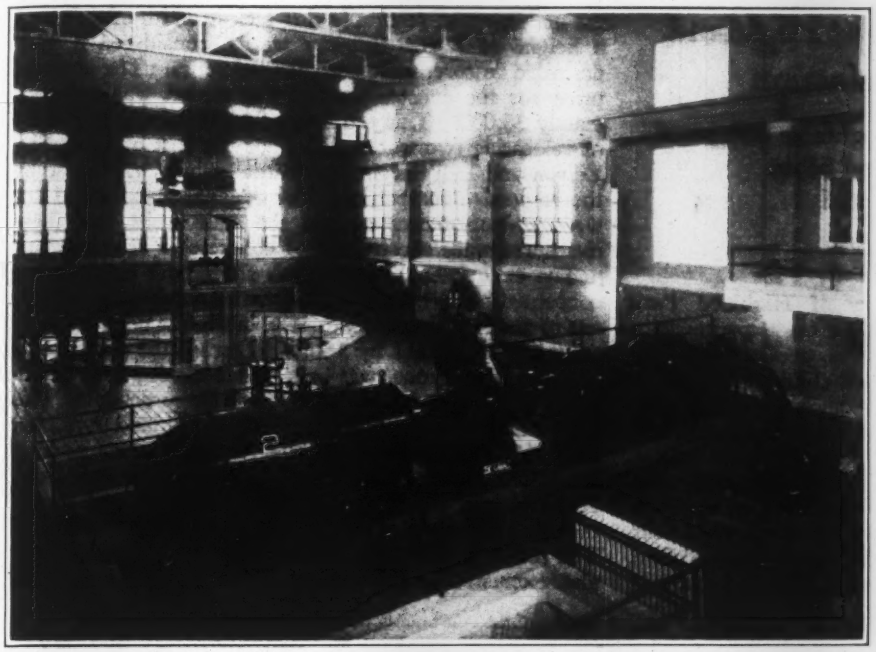


FIG. 7—HIGH-LIFT PUMPING PLANT
Steam turbine at left drives two centrifugal pumps and also the electric generator on the shaft extension at the right. This generator supplies current for motor-driven low-lift pumps in pit at end of room.

below, at the level of the top of the mixing tank. Machines and tanks are under the eye of the station operators.

*Pumping Plant*—A special feature in the layout of this plant is that the shafts of the steam-driven high-lift pump carry generators supplying current to operate the motor-driven low-lift pumps. For the high-lift service there are two turbo-centrifugal pumping units, each consisting of a multi-stage steam turbine geared to a shaft which drives two centrifugal pumps in series, delivering 15 m.g.d. at 350 ft. head. An extension of the shaft is connected directly to a 300-kw. d.c. generator of sufficient capacity to drive one low-lift pump and miscellaneous station motors. One of the units is shown in Fig. 7. These high-lift pumping units are designed for a duty of 191,500,000 ft.-lb. per 1,000 lb. of superheated steam, this work including the output of the generator.

The low-lift pumping plant consists of two centrifugal pumps of 18-m.g.d. capacity against 55-ft. head, driven by 220-hp. motors. Direct current was selected on account of the variable pumping head and to provide high efficiency under a variety of pumping conditions. The pumps have 24-in. suction openings, these exceptionally large openings being provided to secure a maximum of suction lift in case of stoppage of the intake screens. The pumps are set with their bases about 12 ft. above extreme low water.

In tests under heads varying from 53 to 60 ft. these pumping units developed from 78.3 to 79.4 per cent overall efficiency, indicating pump efficiencies of about 85 per cent. Combined with the economy of electric generation, the duty of the low-lift equipment is about 150,000,000 ft.-lb. of work per 1,000 lb. of superheated steam. A small steam-turbine-driven generator is provided to carry the station lighting load when the high-lift pumps are not in operation. A motor-driven pump serves the elevated tank located on the adjoining hillside, for filter washing. Low-lift pumpage, high-lift pumpage and wash-water pumpage are measured independently by Venturi meters.

Coal dumped from railroad cars into an outdoor coal pocket is lifted by a gantry crane with grab bucket to reinforced-concrete coal pockets over the boiler hoppers. There are two 500-hp. water-tube boilers for 300-lb. pressure, with 200 deg. of superheat, served by underfeed stokers. Each boiler is capable of operating one high-lift and one low-lift pump at boiler rating, but either boiler can operate the entire plant at overload. On a test at slightly above rating, the boilers and stokers developed 80.4 and 83.2 per cent efficiency, using coal of 13,800 B.t.u.

The filters, boilers, pumps, mixing tanks, office and laboratory are all housed within one fireproof building (Fig. 1) having reinforced-concrete foundations and floors, and exposed steel roof trusses carrying cement tile which supports tar-and-gravel composition roofing. Tapestry brick trimmed with artifical stone is used for the exterior, the stone consisting of cement and marble chips with all faces cut as in cut stone. Interior walls are finished with enamel brick. Floor surfaces are of terrazzo and tile. As shown in Fig. 2, the building is so placed as to allow for extensions to be built to the west without interfering with the present facilities or encroaching upon the right-of-way of the Southern Railway.

*Distribution System*—Ordinarily the Williams Creek station operates at about rated capacity for such a number of hours as may be required to furnish water for the day's supply, and is shut down during certain hours of the night. Improvements carried out in connection with this station include a 10-m.g. elevated reinforced-concrete reservoir on Richmond Hill, for general water storage for the entire city, and a 1-m.g. elevated reinforced-concrete reservoir in South Knoxville, principally to provide a reserve supply in case of accident to mains crossing the river. The old reservoirs on Filter Hill continue in use to serve a comparatively small low-lying area. During the construction of the new plant, the city made extensive additions to the water pipe system, principally in supplying additional main arteries.

*Engineers and Contractors*—The Williams Creek plant and the Richmond Hill and South Knoxville reservoirs were designed and their construction supervised by Alvord, Burdick & Howson, consulting engineers, Chicago, with W. W. Mathews as resident engineer. They reported directly to Col. Frederick W. Albert, engineer in charge, city water department of Knoxville, who designed and carried out the improvements to the distribution system. The pumping station and filter plant, coagulation basins and Richmond Hill reservoir were built by J. M. Dunn & Son, Knoxville, Tenn. Machinery and equipment were furnished and installed mainly by Burford, Hall & Smith, Atlanta, Ga.

# Pedestrian Subways at Highland Park Give Satisfaction

## Tunnels Under Busy Thoroughfares Safeguard School Children and More Are Contemplated

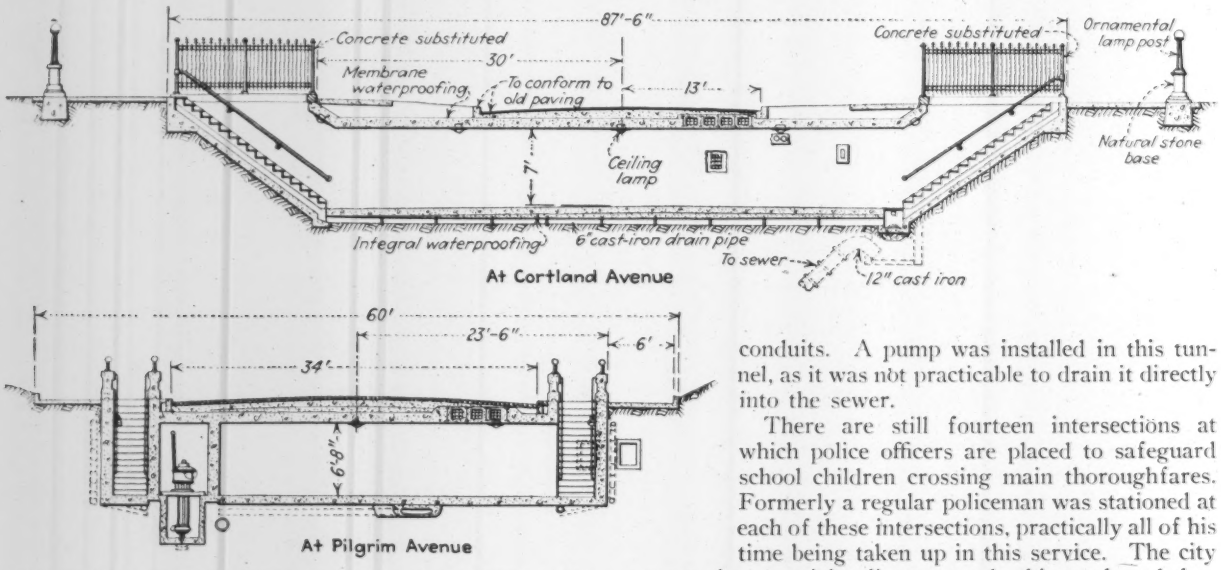
By L. C. Whitsit
*City Engineer, Highland Park, Mich.*

IN THE fall of 1924 the city of Highland Park (Mich.) decided to construct, as an experiment, a pedestrian tunnel under Second Ave. at Cortland Ave. to provide a safe means for school children to cross a busy thoroughfare. At present two such underpasses are in use, a third has been designed and consideration is being given to building others.

Highland Park, a suburb of Detroit, is entirely surrounded by that city and has a population of approximately 60,000. Second Ave., running north and south parallel to Woodward Ave., Detroit's main thoroughfare, is one of the principal arteries leading from the center of Detroit to the northern section of the city and carries a large volume of automobile traffic. At the corner of Second and Cortland Aves. is located one of Highland Park's largest elementary schools, with about 1,200 children enrolled. Half of this number must cross Second Ave. to reach the school. Second Ave. is a 60-ft. street with the pavement width 34 ft. from curb to curb.

The tunnel was constructed of reinforced concrete, the underground section having a clear width of 6 ft. and a height of 7 ft. Subway treads, considered a very desirable feature, were used for the stairs. The contract price for the construction of this tunnel was approximately $5,000. This did not include the cost to the city of relocating two water mains nor the cost of relocating Edison and Bell telephone conduits, which was borne by the respective companies. The original plans called for wrought-iron fences around the stair wells, but these inclosures were constructed of concrete to save expense.

The experiment in so far as the school children are concerned has proved to be successful, as they have made use of the tunnel very faithfully, but it has not been used to any great extent by adults. During the summer of 1927 a second tunnel was built under the same thoroughfare at Pilgrim Ave. near another large school. This tunnel has the same width as that at Cortland Ave., but the height was reduced from 7 to 6⅔ ft. Due to local conditions the stairways were constructed somewhat differently, two stairways being built at each end of the tunnel at right angles to it rather than one in line with it. The contract price on this tunnel was $8,500, which was also exclusive of the cost of moving water mains and conduits. A pump was installed in this tunnel, as it was not practicable to drain it directly into the sewer.




TWO TYPES OF PEDESTRIAN SUBWAYS AT HIGHLAND PARK, MICH.
The main differences are in the entrances and the provision for drainage.

There are still fourteen intersections at which police officers are placed to safeguard school children crossing main thoroughfares. Formerly a regular policeman was stationed at each of these intersections, practically all of his time being taken up in this service. The city now employs special policemen to do this work and they are paid at the rate of $100 a month, thus cutting the cost of patrolling these crossings approximately 50 per cent. The tunnels can, however, still be justified from an economic standpoint as well as from the standpoint of greater safety to the children. In addition, tunnels furnish a safe means of crossing the street for children and the general public 24 hours of the day instead of for a few limited hours during which an officer is stationed at the intersection. A third tunnel has been designed, but the contract for its construction has not been let. Consideration is also being given to the desirability of sub-

NUMBER AND PERCENTAGE OF SCHOOL CHILDREN AND ADULTS USING PEDESTRIAN UNDERPASSES
Count Made by the Rapid Transit Commission of the City of Detroit

| Underpasses | Date | Weather | Between A.M. | Between P.M. | Number of Adults: On Surface | Number of Adults: In Underpass | Number of Adults: Per Cent Using Underpass | Number of Children: On Surface | Number of Children: In Underpass | Number of Children: Per Cent Using Underpass |
|---|---|---|---|---|---|---|---|---|---|---|
| Cortland | 2-14-28 | Rain | 6:00 | 6:00 | 467 | 16 | 3.3 | 80 | 2,043 | 96 |
| Pilgrim | 2-15-28 | Fair | 6:00 | 6:00 | 402 | 12 | 2.9 | 83 | 1,726 | 96 |
| Cortland | 2-16-28 | Fair | 7:30 | 6:00 | 476 | 16 | 3.25 | 102 | 1,956 | 95 |
| Pilgrim | 2-17-28 | Fair | 6:00 | 6:00 | 341 | 15 | 4.2 | 91 | 1,634 | 95 |
| Total | | | | | 1,686 | 59 | 3.4 | 356 | 7,359 | 95.5 |

mitting a bond issue for approximately $150,000 to defray the expense of building tunnels at all the crossings at which officers are stationed at the present time.

The tunnels as built were designed and constructed under the supervision of the writer.

[An article entitled "Los Angeles Will Soon Have 44 Pedestrian Subways" appearing in *Engineering News-Record*, May 17, 1928, described how similar subways have been built in Los Angeles under a bond issue of $350,000. They have been found so desirable that many others have been asked for.—EDITOR.]

# Corrosion of Boilers Checked by Electrochemical System

## Flow of Electric Current Is Maintained in Boiler, With Arsenic in Water—Trials Show Good Results

BOILER CORROSION is one of the troublesome problems encountered by engineers having charge of steam plants. An electrochemical polarization system that has given satisfactory results when applied to locomotives is said to be applicable also to the boilers of water-works and other utility and industrial plants. This system was described recently before the Illinois Section of the American Water Works Association by O. W. Garrick, water engineer of the Wabash Railway. A summary of his paper follows.—EDITOR.

TWO basic causes for corrosion of iron are electrolysis and local galvanic action. The former is due to electric currents generated by some external force passing from the iron to the water, while the latter is due to electrically different parts of the iron caused by heterogeneity and various other influences. A system for the prevention of corrosion must effectively counteract these two main types of current flow.

The electrochemical polarization system has been developed in the locomotive field, but a water-works man is interested in the effects the water he supplies the locomotives has upon the boiler parts and general locomotive operation. Complaint that he is furnishing an undesirable water, whether due to its incrusting, its foaming or its corrosive quality, may be an influential factor in justifying a change of supply or a method of treatment. With about 72,600 locomotives in the United States, it is estimated that from $12,000,000 to $15,000,000 is spent annually for repairs to pitted and corroded boilers. The type and location of the corrosion vary considerably, but pitting and grooving are the most destructive, no matter where they take place.

At Bloomington, Ill., the switch engines of the Chicago & Alton Railroad, using a very hard city water, begin to have flue failures through pitting in as short a period as nine months. It is frequently necessary to discard from $200 to $1,500 worth of pitted flues, and sometimes the entire firebox, bringing the total corrosion damage up to $2,500 or $4,000 each time the engine is shopped. In October, 1924, a polarization system was installed in a yard engine and in a passenger engine, under the supervision of L. O. Gunderson, chemical engineer for the railway. These test installations gave immediate protection against the corrosion of the boiler interior, and only slight changes have been made up to the present time. On these engines the positive pole of the headlight generator is connected to resistance coils and fuses located in a metal box in the cab, from which the connecting wire runs to two electrodes protruding through the boiler shell at diagonally opposite points. These electrodes are connected to two insulated anodes of iron pipe, both of which are at all times below the surface of the boiler water. The negative pole of the generator is grounded to the boiler shell, thus causing the direct current to flow through the resistors to the anodes, and from the anodes through the boiler water to the submerged portions of the boiler and back to the negative pole of the generator, thus completing the circuit. The resistance units are made to provide approximately 2 volts and from 2 to 3 amp. to each electrode, giving about 2 milliamperes per square foot of protected surface.

The imposed current eliminates any electrolysis currents that might originate externally or be set up by thermal differences in the boiler, but since the greatest amount of corrosion is due to galvanic action, the fundamental work of the imposed current is to maintain, in conjunction with arsenic plating, a protective film of hydrogen on the cathodic surfaces of the boiler. The arsenic plating is maintained by feeding to the boiler an arsenic salt, about 2 to 4 lb. per month. One of the reasons for using arsenic instead of any other metal is the ease with which it can be plated upon iron; in fact, it will plate out by immersion and in this respect is similar to copper. But the most important reason is the high discharge potential it has when hydrogen is plated upon it. This rapidly causes polarization of the galvanic couples set up upon the metal surface, and due to the function of the countercurrent supplying an excess of hydrogen to react with the oxygen or other oxidizing agents entering the boiler, the protective hydrogen film will be undisturbed. The arsenic plating alone would not prevent corrosion if there were any oxidizing agents present to remove the hydrogen film, thus disturbing the equilibrium set up by its polarizing effects.

In the locomotive boilers, the iron pipe anodes extend almost the entire length of the flues; thus, with low voltage, good distribution of current is insured throughout the boiler. Only enough current is required to plate out sufficient hydrogen to maintain the polarization of the arsenic-plated cathode areas and supply an excess amount of nascent hydrogen at the boiler metal surface to reduce chemically any oxygen which may diffuse through to the metal surface. The system requires that the imposed direct current be supplied to the electrodes whenever the locomotive is in service, so as to maintain enough excess hydrogen to react with the oxidizing agents entering with the boiler feed water. The additional load on the generator amounts to approximately 125 watts, which will cost in steam consumption only about ½c. per hour when the generator is run for lighting purposes. When the generator is run to supply current only to the anodes, the cost will be about 2c. per hour. To eliminate the use of the generator during daylight hours, an electric storage battery is installed.

For 3½ years the electrochemical polarization process has prevented corrosion in the boilers. There has been practically no maintenance expense. The cheap anode pipes last from three to four years. The process is being applied to all locomotives of the Chicago & Alton Railroad, while installations have been made on the Wabash Railway and other lines. There is a similar corrosion problem in the water-works field, and it is believed that this can be reduced materially by a slight modification of the process as applied to locomotives.

# Experimental Engineering Without Equipment

## Improvised Apparatus Often Gives Satisfactory Answers to Perplexing Field Problems—Several Examples From Experience

By Arthur M. Shaw
*Consulting Engineer, New Orleans, La.*

FREQUENTLY the engineer is called on to render an opinion as an aid in selecting materials, or to furnish an explanation for some phenomenon which may, perhaps, be used as a basis for legal action. To have value, such an opinion must be based on definite knowledge, which is secured from past experience, from a study of the recorded experience of others, or by experimentation. The securing of experimental data of a routine nature may usually be intrusted to one of the commercial laboratories, but there are occasions when isolation, or the peculiar nature of the problem to be investigated, compels the engineer to fall back upon his own resources.

In the study of damage or personal injury claims conditions are frequently met for which no precedent may be found, and for which no standardized method of study has been established. The study of such problems is almost certain to lead along pioneer lines. In such a case preconceived ideas are to be avoided or, if they persist, the first efforts should be directed toward disproving them. Every possible avenue should be investigated, and proper weight assigned to each observed phenomenon before attempting to establish a "law."

Four cases in which pioneer thought and experimentation were necessary, and which necessitated the use of unusual apparatus, are given here as examples of experimental procedure.

### Testing Cement

Several years ago, some heavy concrete construction was in progress at a rather inaccessible point in Mexico. A standard grade of cement of known good quality was available at a reasonable price (considering cost of transportation) and this was to be used on all the more important parts of the work. For the less important details, the owner wished to consider the use of several hundred barrels of cement which had been in storage for some time, and which had been offered at a price about one-half that of the cement of known quality. No standard testing equipment was available, but it was decided that even such crude apparatus as might be devised in the field would give a fairly good idea of the comparative qualities of the two cements. No attempt was made to secure absolute values, but every test was made in duplicate, one member being made of the known cement and one of the unknown, a special effort being made to maintain uniform conditions.

A large number of thin "pats" were made up, using a metal ring as a form. This ring was about ¼ in. deep by 4 in. in diameter and was placed on a flat glass for filling. An effort was made to determine the time of initial set by using a pocket knife, but this was discarded, as the results indicated a lack of uniformity in operation. Several of the disks were broken on the third day, and others on the seventh day. On the three-day test, the disks made of neat cement of known quality broke with a decided pop, while there was practically no sound from the breaking of the disks of cement of unknown quality. Tests of disks of a 1:2 mixture of cement and sand gave comparable results excepting that the cement-sand disks, using the unknown cement, crumbled into several pieces, with considerable disintegration into small particles. All disks were broken in the hands and the known cement disks were very noticeably harder to break in each case.

Small beams, 1x1x6 in., were cast in metal molds, using the 1:2 mixture, and broken at the end of three and seven days. These were placed as a simple lever with equal arms, and a bucket of sand was used as the breaking weight. The quantity of sand required for breaking was measured in a glass graduate. With the exception of one beam, which had an obvious flaw near the fulcrum point, the beams of known cement broke with remarkable uniformity, while a wide range of loads was required to break the others. One supported only 60 per cent of the load required to break the weakest of the beams of known cement, while all others broke at less than 50 per cent.

At the end of a seven-day test it was decided not to employ the cheap cement, but, as a few of the beams were still on hand, these were broken about a month later. The results confirmed the decision that use of the cheap cement was not to be considered.

### Determining Concrete Flowability

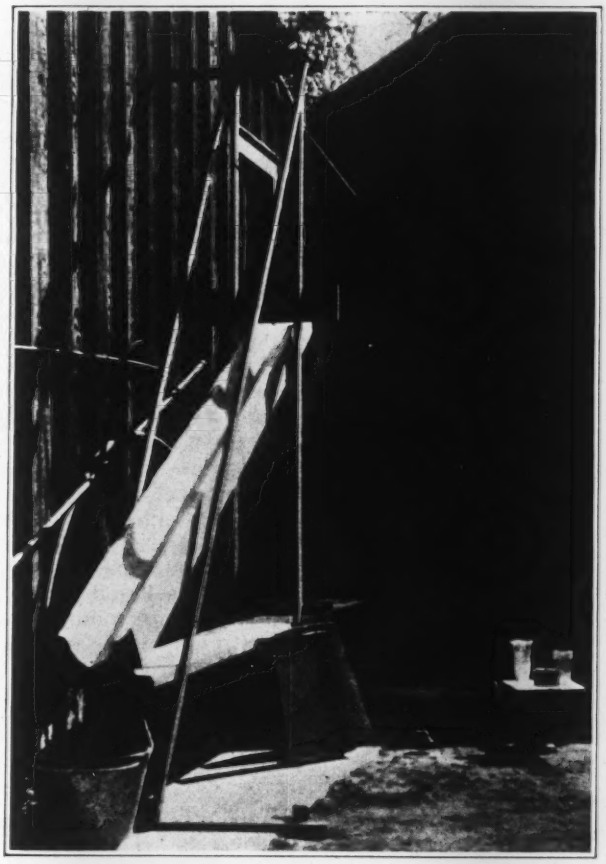
In the design of an important structure, it was necessary to secure a high-strength, dense concrete. The chuting method of placing was dictated both by the nature of the structure and amount of materials involved. A tentative basic mixture was adopted which, it was assumed, would give the required strength and degree of impermeability and which would contain sufficient water to permit successful chuting. Before the final specifications were written, a cement was offered for which many advantages were claimed, those which appealed particularly to the engineers being the lower price and the quality of "flowability" which it would impart to concrete if used with standard portland cement in the recommended proportions of one to three. (For convenience, this cheaper cement will be referred to as the *X* cement.) The engineers were satisfied as to some of the claims made for the *X* cement, but sought confirmation concerning the qualities of freer flow.

Correspondence with a number of testing and research laboratories developed the fact that there was considerable interest in the matter of flowability, but the replies indicated that no satisfactory method had been evolved for securing definite data. The standard slump test was considered as affording an indication but was not generally accepted as being a complete index. In an attempt to secure the desired information, a crude chute was erected and tests were made in pairs, using a standard grade of portland cement in one member of each pair. The apparatus used is shown in the accompanying illustration, and consisted of the following: One galvanized iron trough, semicircular, 6 in. diameter, 8 ft. long; one

platform scale with a capacity of 35 lb.; one glass graduate; one watertight sheet iron pan, 18x24x3 in.; and one trowel.

Cement and aggregates were measured by weight, the glass graduate being used in measuring the water. No effort was made to determine the moisture content of the aggregates, as they had been in sheltered storage for several weeks and were practically dry. All batches contained the same amount of cement, sand and gravel, the only variation in total weight being the slight one due to changes in the water content of the various batches.

To secure rigidity and uniform conditions of chuting, the metal liner was placed in a wooden trough which was hinged to a vertical frame at one end. A hoisting rope passed over a pulley to a counterweight which was heavy enough to raise the trough and the batch of concrete readily. As soon as a batch had been placed in the trough, the counterweight was released and the trough was tilted quickly to the desired angle. It was brought to a sudden stop by striking a crosspiece on the hoisting frame. This jar was sufficient to start the concrete sliding down the chute. At the end of twenty seconds, the chute was brought back to a horizontal position and the liner was removed and weighed to determine the amount of material remaining. This retained material was used in computing the relative flowability of the various mixtures tested. After each test the liner was flushed with water and wiped out with a wet rag. Thirty test runs with this apparatus gave sufficient data to settle satisfactorily the question of the flowability of concrete made with this material and in the proportions stated.



CHUTE FOR MEASURING FLOWABILITY OF CONCRETE

### Vibration of a Building

A pumping plant was constructed on a land reclamation project. The soil, to a depth of nearly 40 ft. was of muck or soft clay with only a few thin strata of sand. Piles were driven to a good bearing in sand at the 40-ft. depth, these serving as sub-foundations for the mass concrete which was poured as a monolith to support the two pumping units and the house. Each unit consisted of a 120-hp. horizontal semi-Diesel engine, direct-connected to a 36-in. centrifugal pump, operating at 180 r.p.m.

On commencing operations after the plant was completed a swaying of the entire foundation of $\frac{3}{4}$ in. was reported by the manager. The designing engineer was hurriedly called to the job for consultation and his first inclination on seeing the plant in operation was to accept the manager's estimate. To measure this movement, a heavy pendulum fitted with a point was swung from the roof truss, and a piece of smoked glass was attached rigidly to the concrete floor immediately beneath. This showed the extreme movement to be slightly less than $\frac{3}{16}$ in. A check was made by setting a transit at a considerable distance from the building and sighting at marks on the concrete. Even with the knowledge that the amplitude of sway was only about one-fourth that originally estimated, the constant movement was disconcerting and caused some anxiety, especially as the structure served not only as a foundation but also as a dam. Ten years of operation without developing any weakness has caused the owner's (and also the engineer's) anxiety to subside.

### Transmission of Vibrations

The owner of a residence situated 218 ft. from an engine and pump house claimed that the brick pillars which supported his house had become weakened, and were failing as the result of vibrations set up by the operation of the pumping engine. The soil was a sandy clay, well drained. The house rested on brick pillars which stood 3 ft. above the ground. Several of the pillars were badly out of plumb and were in obvious need of repair.

The engine was a 75-hp., two-cylinder, vertical semi-Diesel, operating at 284 r.p.m. It was belt connected to an air compressor for air-lift pumping.

To measure such vibrations of the residence as might be detected, an engineer's transit was fastened rigidly to a small wooden platform and the transit, with its improvised base, was suspended as a pendulum from the ceiling of a front porch of the house by steel wire. A thin board, wide enough to have considerable stiffness against horizontal forces was fastened rigidly to the transit base and extended back to the sill of a window of the house. A small hole was drilled in the free end of this stick and a finishing nail (which made a snug fit) was driven through this hole and into the window sill. A level rod, graduated to hundredths of a foot, was placed in a horizontal position at a considerable distance from the transit, the rod being approximately on a radial line from the pump house and at right angles to the line of sight of the transit. If the engine caused a movement of the house, this would cause the transit to rotate in a horizontal plane and to indicate the angle of rotation by the passage of the vertical cross hair across the face of the graduated rod. As there was a light breeze

blowing considerable difficulty was experienced, but after some practice, it was possible to get observations of nearly a quarter of a minute with no apparent movement. Then the engine was started and an effort was made, extending over about half an hour, to detect some movement which might be attributed to it. None occurred excepting from other, and easily explainable, causes. The first was from the careless slamming of a door at the rear of the house. Five distinct oscillations were observed, starting off with a maximum of 0.005 in. Moderately heavy footfalls on the front porch caused a movement of about 0.002 in. It was estimated that the apparatus was sensitive to a movement of 0.001 in.

As there was a pronounced, though very slight, vibration of the engine while in operation, an effort was made to determine the limit of distance through which this disturbance might be detected. A small porcelain dish, such as is used for mixing watercolors, was partly filled with mercury. By watching reflections of light from the surface of the mercury, extremely slight movement may be detected. The mercury dish first was placed on a window sill of the pump house. Considerable flickering of reflected light was noted here, though there was no movement of the house which was noticeable to the touch. The dish was moved to the concrete pedestal of an elevated water tank 65 ft. from the pump house. At this point, the faintest change of light reflections was noted. At a point 165 ft. from the pump house, the mercury dish was bedded firmly in the ground, with no sign of agitation of the surface of the mercury. Each of these positions was in a line toward the house which was under investigation. Observations next were made at the house, with the same negative results.

An effort also was made to determine the radius of disturbance through the air, assuming that the exhaust of the engine might have some effect. This exhaust passed through a muffler and thence through a vertical pipe which terminated about 20 ft. above the ground. An aneroid barometer was used to measure variations in air pressure which might be caused by the exhaust. No movement of the needle was observed even at points not more than 20 ft. from the point of exhaust. The instrument used is sensitive to a variation in pressure of one ounce to the square foot. It registers the change in pressure caused by the quick (but not violent) opening of a door in a room 16 ft. square.

Owing to the uniformly negative results secured, the conclusion was reached that the operation of the engine was not a contributing cause to the defective conditions of the foundations.

### To Tow Dry Dock From England to Singapore

Preparations are practically completed for towing of the seven sections of a large dry dock from England to Singapore, Straits Settlements. The seven sections will be towed a distance of 8,500 miles in two groups; four sections in the first group and three sections in the second. Special arrangements have been made for the passage through the Suez Canal, which is expected to take four days for a distance of only 100 miles. To minimize interference with the regular traffic of the canal both sections will go through at the same time. Although the sections have a draft of only 7 ft., the surface which is presented to the wind is 75 ft. high, and for this reason a considerable element of risk enters into the towing operation. Insurance to the value of £900,000 has been secured to cover the risk of the tow.

# Philippine Island Highway Construction Methods

## Primitive Tools and Cheap Labor Serve to Build Modern Roads on Oriental Soil—Unique Methods of Construction

By Marcial Kasilag

*Chief Constructing Engineer, Bureau of Public Works, Manila, P. I.*

This Is the Second of two articles on Philippine highways, the first of which, describing routes and general planning and development policies, was published in the issue of Aug. 2, 1928. —Editor.

WATER-BOUND macadam has thus far been the type of construction most common for country roads in the Philippine Islands. The practices described here refer mostly to this type. In considering these practices rainfall conditions must be kept in mind. The annual rainfall in the Philippines varies from 40 to 120 in., while in a typhoon of 1911 the rainfall intensity reached 48 in. in 24 hours in the mountain region of the island of Luzon. In a series of typhoons in July and August, 1919, Manila registered 94 in. in 60 days.

*Roadway Crown*—It has been determined that a heavy crown of $\frac{3}{4}$ to 1 in. per foot is detrimental. First, the water from heavy continued rains forms in rivulets, destroying the metaling, while if a flat crown is used, the water runs off in a continuous sheet. Second, a heavy crown tends to concentrate wheel traffic on that central portion of the road where the vehicle can maintain a level position. Third, the edges of steel-tired and solid rubber-tired vehicles, owing to uneven bearing, cut like a knife-edge into the metaling. A crown of $\frac{1}{2}$ in. on 1 ft. or 1/50 of the width of the metaling, has been found to meet Philippine conditions best, whether the road is asphalted or not.

*Establishing Grades*—The grade through rice paddies is raised slightly above the average tops of the paddy dikes. In rolling country the grade line follows the contour of the ground more closely, as usually the drainage is perfect and no trouble is encountered from water standing or running continuously against the slopes and keeping the subgrade wet, as in rice paddy sections. The grade on coastal roads is kept well above high tide and is protected from the surf, which may do serious damage during storms. Sometimes along coastal routes an arm of the sea or an estuary formed by the mouth of a river is crossed in order to shorten the distance. This makes a rock causeway necessary.

Establishing grades in hilly or mountainous countries presents the worst problem, owing to the unstable character of formations, which have been disturbed by earthquake shocks, and also because of the usual necessity for very heavy grades, which are subject to the devastating effect of heavy rains. The famous zigzag mountain roads in the Benguet hills, north of Manila (Fig. 1), are outstanding examples of success in conquering these heavy grades. For through roads 5 per cent is the limit of gradient, but for intermunicipal, vicinal and feeder roads grades as high as 7 per cent are permissible. Even 8 per cent has been used in places where funds are limited and the country is very rough. The crown on heavy grades is increased considerably in order to shed the water more quickly into side ditches, thus preventing the

formation of little brooks along the middle of the highway.

*Tools and Equipment*—Various methods are practiced in building up the sub-grade, but the use of modern road machinery has, so far, been quite limited. The wheelbarrow is probably the most useful piece of equipment used by Filipino road builders. It is used to move earth from the cut or ditch to the roadbed. One man loosens the material, another loads the barrow, another wheels it to the embankment, and still another levels off the earth after it has been dumped. This operation requires four men, who move from 8 to 10 cu.yd. of earth per day under proper supervision and direction. Common labor wages in the Philippines at present range from 80 centavos (40c. U. S. currency) to 1½ pesos (75c.) a day. Another primitive piece of equipment used in Philippine road building is a small bamboo basket swung from a bamboo pole and carried on the shoulders of two men, Chinese fashion; and an even smaller bucket is designed for one man to carry on his shoulder. Bamboo sleds hauled by carabao, or water buffalo, carry boxes filled with excavated material, and drag scrapers (Fig. 2) are made from bamboo for carabao work. Most of the equipment is still primitive, but road graders and motorized tractors are beginning to come into use. Although they are found only on occasional big jobs of road work, some people see in their use the beginning of the end of universal man power in the Orient.

*The Task System*—The most effective and economical method for most of the road work in the Philippines is the so-called task system, which consists in letting out short sections of the sub-grade work to gangs of laborers at a stipulated price. The work is required to be done in a given contract time, but usually the time has to be extended. Road work in the rice paddies and coastal lands is parceled out in sections of from one to five stations of 20 m. each, or about 65 ft. The number of sections to a gang depends on the number of men in the gang, and the cost is a little less than doing the work by day labor. Under this system grading work can be accomplished at an average price of 50 centavos per cu.m. Laborers are furnished with all tools and accessories, and where blasting is required, dynamite is supplied free. It has been found more difficult to apply this system to work on mountain roads owing to the fact that the average common laborer cannot figure out the volume of earthwork on side hill sections. More intelligent laborers take the word of the constructing engineer, and will work sections of a given volume at a price fixed by him. Regular contractors take contracts by the cubic meter.

FIG. 1—SWITCHBACK CONSTRUCTION IN THE MOUNTAINS, BENGUET ROAD

FIG. 2—CARABAO HAULING BAMBOO SCRAPER

Where mountain grading is done under the task system, as occasionally happens, a curious system of counting up the excavated meterage is in vogue. Pillars of earth (Fig. 3) are left in the middle of the road, with a tuft of sod on the top of each, so that when the time comes for computing the volume of material excavated accurate measurements can be taken. In this manner nobody can gainsay the amount of stuff laboriously excavated with pick and shovel and the laborer is satisfied that he is not being cheated. When the price is agreed upon the gang sets to work and removes the pillars.

*Road Thatching*—High road fills are effectively protected by sodding, but when there is no time for sod protection to take root before rains are to be expected, cogon thatch is resorted to as a means of preservation. Cogon is a hardy perennial grass 3 to 5 ft. high, which smothers out all other plants in its territory. It is applied in practically the same manner as roofing is applied to nipa shacks. This thatch lasts about a year on the ground and can be placed at a cost of about 5 centavos per sq.m. Plants or stalks of another quick-growing plant known as the talahib are planted at random all over the slopes of the embankment for permanent protection. These can be planted through the laid thatch by simply inserting a sharpened stick through it, thus making a hole in the earth beneath which to set the growing plant. The grass grows and spreads with great rapidity, so that, by the time the thatch has rotted to the point of unserviceability, the growing stuff will give ample protection.

*Surfacing Materials*—Broken stone, gravel or coral, or a combination of any two, is used for surfacing materials. Several methods have been used successfully in constructing the metaling. One widely used method employs first a course of broken stone, 4.5 to 6 in. deep, composed of loose stones varying in size from 2 to 4 in.; then a second course from 3.9 to 6 in. deep with stones

varying in diameter from 0.8 to 1.5 in., packed according to the density of the traffic expected, and finally, a binder of rock screenings, or fine gravel and sand. Another mode of construction uses three courses of gravel of about the same size placed in the same manner as the broken stone, except that a binder of sand and clay mixture is used in order to secure compaction of each course under the roller. A third method uses simply a first course of broken stone and a second of gravel. The fourth method is to place adobe-stone telford 11.8 in. deep with a top wearing course of broken stone 4 to 5 in. deep and the usual binder. A telford of coral is also used 8 to 12 in. thick with a top course of finger coral. The coral used in telford base is found in deposits along the seashore and can be quarried with a pick. The finger

FIG. 3—EARTH PILLARS FOR CHECKING EXCAVATION

coral used for the top course is plentiful along the coast lines, being washed out by wave action.

In every case, each course is rolled independently with an 8- or 12-ton roller. Coral roads cost little to construct, averaging from 5,000 to 6,000 pesos per km., exclusive of structures. As the cementing quality is high, the coral presents a very smooth, white surface and justifies its use where traffic is not too heavy, as it forms a good base on which to build a more durable surfacing when traffic calls for it. Gravel and broken stone roads cost, exclusive of structures, from 6,000 to 12,000 pesos per km. in the lowlands, depending on the nature of the country and the materials encountered in building the sub-grade.

*Preparing for Floods*—It is often necessary to locate roads across rivers with high-water channels half a mile or more wide, and with undefined banks. Where relocation on higher ground is not practicable these sections of road are maintained, if an ordinary macadam road would be destroyed by floods in the rainy season, in the following manner:

First, if funds are limited cogon grass is cut and laid on top of the sand in line with the road and covered with a thin layer of sand to keep it from being blown away by the wind, or bamboo mattings may be used instead. One application of either of these mattings lasts the entire dry season, which varies in different localities from six to eight months.

Second, if there is plenty of money a concrete overflow or spillway is constructed. This is simply a concrete road built high enough to be above ordinary low water, but not so high as to act as a dam under flood conditions. It is provided with pipe drains or low bridges to carry the low-water flow. In flood periods water goes over the structure and traffic may then be held up for a day or two. As protection against scour the downstream slope is made quite long and given an ogee shape, and the baffle and apron walls are carried down a yard or so under the streambed. This type of construction has been found very successful and economical where otherwise the stream crossing would be impassable during the entire rainy season without a bridge, which might cost ten times as much as the spillway construction.

*Other Flood Construction*—In some places sections of ordinary macadam road which are subject to flood overflow are effectively protected by building an earth dike with thoroughly sodded slopes about 1' ft. high on the downstream shoulder of the road. The dike protects by producing a layer of dead water, thus preventing the surface material from being washed out by the current. In places where the current is too strong for this type of construction it has been found more practicable to throw up a concrete overflow section of simple design on a sub-grade slightly raised above the natural surface of the ground than to erect a high embankment and build the necessary bridge. Such overflow sections usually consist of a pavement of plain concrete, 1:6 mixture, built in alternate sections of convenient lengths and provided with transverse expansion joints filled with tarred paper or asphalt. Pipe drains are put in to take care of the low-water flow. The shoulders and slopes are made of clay, but the slopes must be built as flat as possible. These sections must be thoroughly rolled with 10- or 12-ton rollers and sodded with a grass similar to Guinea grass, which grows abundantly all over the islands.

If the material available for the sub-grade is heavy clay, which cracks badly in the dry season and becomes soft plastic mud in the rainy season, it is well to place and roll thoroughly on top of the earth sub-grade a layer of gravel, sand or broken stones 3 to 6 in. thick in order to minimize the danger of the concrete cracking from the expanding and contracting action of the earth underneath when water by capillary action of the soil finds its way down into the sub-grade. If the material is sandy or gravelly, the concrete may rest directly on it.

## German Railway Bridge Moved 11 Miles

An extraordinary engineering feat has just been accomplished in the trans-shipment of a three-span railway bridge, weighing about 1,000 tons, from its former position across the Weser River, near Bremen, Germany, to a spot some 11 miles farther upon the river, where it is being re-erected to serve the traffic between Achim and Thedinghausen.

Each section, about 100 ft. in length, was mounted separately on two 1,000-ton barges into each of which a framework was built to support the load. The barges were sunk by water ballast deep enough to move under the spans allotted to them. The sections were raised from their piers by pumping out the water from the barges, so that each section rose and could be removed without jamming. They were then towed separately up the river by pairs of tugs, while a third tug followed in attendance upon each section to prevent it from fouling the banks at the turns. The journey was successfully accomplished without incident.

# New Design Steel Towers Used in Triangulation

## Government Finds Advantages Follow Substitution of Steel for Wooden Type—Can Be Used Many Times

By J. S. Bilby
*Chief of Party, U. S. Coast and Geodetic Survey*

On GEODETIC surveys covering wide expanses of territory, the curvature of the earth makes it necessary to elevate the observer and his instrument, and also the object upon which he makes his observations, on towers well above the ground level. The towers also prevent trees, buildings and other objects from obstructing long sights. For many years the U. S. Coast and Geodetic Survey used wooden towers exclusively for this purpose. Before the war, when lumber and labor were cheap, these could be built at a reasonable cost, but in recent years the rapidly mounting cost of lumber and labor and the fact that wooden towers cannot be dismantled, moved forward and erected for use again, have almost prohibited their use because of the expense involved.

The type of wooden tower formerly used on first-order triangulation is shown in Fig. 1. It consisted of an inner tripod for the instrument and an entirely independent outer four-sided scaffold to support the observer. The superstructure of the latter carried a signal lamp. A 75-ft. tower required 4,700 ft. of lumber and 250 lb. of nails. Five experienced men were needed for an average of three days for erection. Adding to this the cost of transportation of the party, hauling lumber from the yards to the place of building and sundry other expenses, the total cost was about $400 per tower.

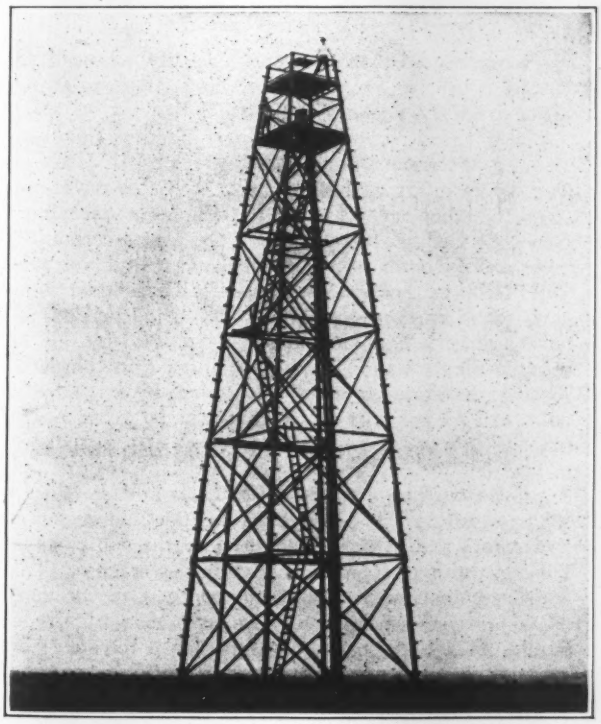


FIG. 1—75-FT. WOODEN TOWER FORMERLY USED FOR MAKING LONG SIGHTS
An inner tripod bears the instrument; the other scaffold supports the observer.

During the winter of 1926 preliminary plans and specifications were prepared by the writer at the Washington office of the Coast and Geodetic Survey for a steel tower that could be repeatedly erected, taken down and moved by truck to a new station. Later the preliminary plans were taken to the factory of the Aermotor Company in Chicago. With the aid of the engineer of that company and after several tests and modifications, a complete tower was constructed and erected at the factory. There were three essential requirements to be satisfied to make the steel towers a success: first, great rigidity and stability against vibration and against twist in azimuth; second, the tower should be readily erected and taken down; third, the total weight should not exceed 2½ tons, in order that a moderate-sized truck may transport the tower from station to station.

After the first tower had been completed and erected at the factory, a final test was made. The results were so satisfactory that the director of the U. S. Coast and Geodetic Survey authorized the construction of thirteen additional towers. The initial tests at the factory showed clearly the degree of rigidity and elasticity which could be expected, and the following specifications were drawn for the additional towers:

*Inner Structure*—Horizontal displacement: A horizontal pull of 400 lb. at top of inner structure must not displace the top by more than ½ in.

Angular displacement: A tangential horizontal pull of 50 lb. applied at the corner of the top of inner structure must not cause an angular displacement of the top of more than one minute of arc. This corresponds to a horizontal displacement of the corner of the structure with relation to the center of about 0.002 in. A tangential horizontal pull of 50 lb. at the corner of the inner structure 23 ft. below top must not cause an angular displacement of the top of the structure of more than 50 seconds of arc.

Vibration: A wind velocity of 20 m.p.h. average ove. one-minute intervals shall cause the top of the inner structure to vibrate in azimuth not more than ten seconds of arc.

Semi-permanent Change in Azimuth: Gusts of wind of a velocity of 35 m.p.h. or less shall not cause a semi-permanent angular displacement of the top of the inner structure of more than two seconds of arc.

*Outer Structure*—A horizontal pull of 500 lb. at center of side of outer structure at height of floor platform, the pull being applied through a bridle attached to two of the main posts, must not displace the outer structure horizontally by more than 3 in., nor cause the buckling of any members. The same pull applied to a corner post of the outer structure at the height of the platform must not displace the top of the structure horizontally by more than 5 in., nor cause buckling of any member.

A complete steel tower is shown in Fig. 2. It consists of an inner and an outer tripod, each separate from the other. The theodolite is mounted on the apex of the 75-ft. inner tower, which projects through an opening in

the observer's platform on the outer tower. Above the latter is a 10-ft. superstructure on which is mounted the signal lamp and the light-keeper's seat. The towers are constructed somewhat along the lines of a three-post windmill tower, but differ in essential features which insure greater rigidity and stability. Both the inner and the outer towers are built in 14-ft. sections, so that any number of sections can be used to vary the height. The total weight of the 75-ft. inner tower and of the 85-ft. outer tower is 4,000 lb., including the anchors and anchor sills.

Fourteen of these steel towers were used on the triangulation in South Dakota and Minnesota during the summer of 1927. Their success was evident from the erection of the first towers and the completion of the first set of observations on them. One of the great disadvantages of the wooden towers, besides the question of cost and availability for use at only one station, was the fact that observations were impossible during very high winds. The steel towers proved to have very little twist in azimuth, and were so free from vibration that observations could easily be made when the wind had a velocity of 25 m.p.h.

*Organization of Parties*—After the work was begun and all parties were organized, one chief of party (the writer) had charge of the construction, and one chief of party had charge of the observing. The construction party consisted of three sub-parties: two advance parties of four men each and one rear party of four men. Two men, each with a 2½-ton truck, moved the towers forward. There were two observing parties, one on each side of the scheme of triangulation. The two chiefs of party kept in close touch with all operations, so that everything moved like clockwork. As soon as the observations on the rear towers were finished, the rear construction party began to tear down the towers. Then the material of the complete tower was loaded on one of the 2½-ton trucks and moved to the site of a new station, sometimes 100 miles ahead, where one of the advance parties immediately began to re-erect it. Each sub-party was provided with a truck as a means of transportation. Each forward party carried an extra set of anchors. As soon as it reached the site of a new station, holes were dug and the anchors set, so the party was usually all ready to begin re-erecting the tower as soon as it arrived.

Twelve towers were in use during the greater part of the season. Usually ten were standing during the time the two rear towers were being taken down, moved forward and re-erected. Towers were erected, taken down, moved forward and re-erected at 90 stations during the three-month season along the 475-mile arc of triangulation. Each tower was moved seven or eight times. The towers are so constructed that all parts are interchangeable and, in case of damage, any part can be replaced with a new part. At the end of the season the towers showed very little depreciation.

It was demonstrated a number of times during the season that the steel towers can be taken down quickly, moved forward 90 miles or more and re-erected at the new station without any extra effort on the part of anyone concerned. Usually two towers were ready to be taken down on the same day. The rear party of four men would start tearing a tower down at 7 a.m.; by 9:30 or 10 a.m. the tower was loaded on one of the 2½-ton trucks and ready for the moving party to take it forward. The rear party would then break camp, move to the second station, usually a distance of 12 to 15 miles, and by 2 p.m. the second tower would be down and moving to the front on another truck. It usually required from 3 to 3½ hours for one of the forward parties to erect the tower after the anchors were set.

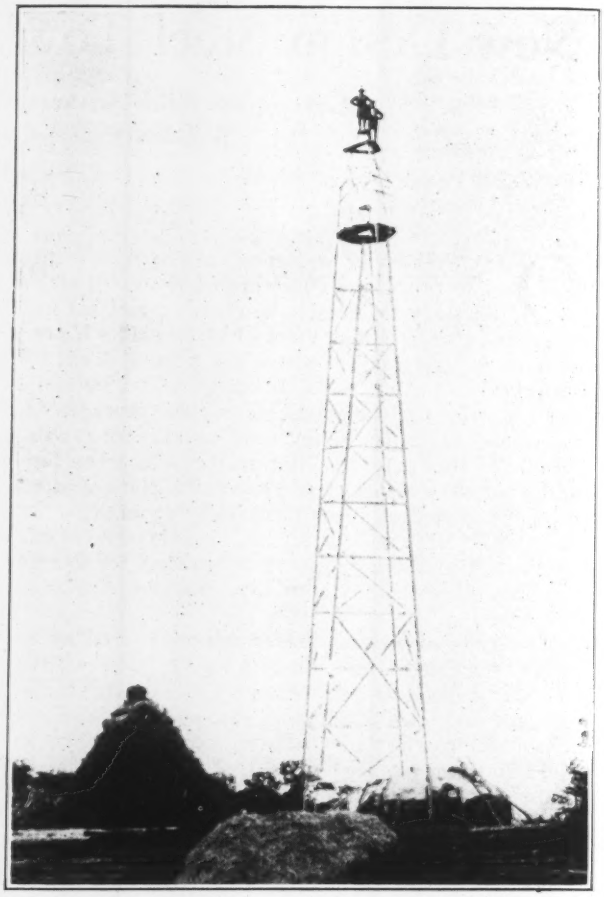


FIG. 2—STEEL TOWER NOW USED BY THE COAST AND GEODETIC SURVEY

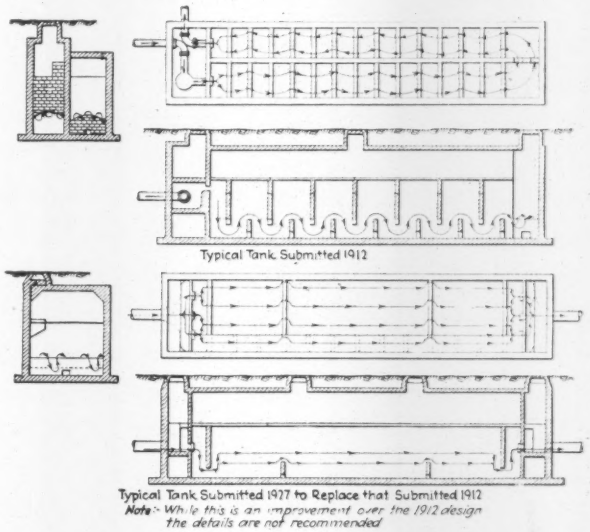
The anchors for both the inner and the outer towers were set in the same holes to a depth of 4½ ft. They were placed 1 ft. apart so that no jar to the outer tower would affect the inner one, on which the theodolite was mounted. After the anchors were in place, the first sections of the inner and the outer tower were bolted on, and both towers were built up section by section. Three men worked aloft while one man sent the parts up as needed. The parts are very light and are easily hoisted by one man, using a single hauling line through a 6-in. block. All parts of the inner tower were marked by a band of red paint and all parts of the outer tower by a band of blue paint. This made easy the separation of the parts.

The average cost for tearing a steel tower down, moving it forward an average of 90 miles and erecting it at the new station was $140, which included depreciation of the towers and of the trucks used by the sub-parties for transportation of themselves and the towers, as well as all overhead expenses. This is in contrast to the cost of $400 for each station for wooden towers of the same height. The total cost of construction of the steel towers at the 90 stations used in the season of 1927 was $13,600, as against an estimated cost of $36,000 if wooden towers had been used. Aside from the great difference in cost, the steel tower has proved to be superior in every respect to the wooden tower. Its use speeds up not only the construction work but also the observing.

# Type of Sewage-Settling Tanks on North Jersey Coast

## Single-Story Tanks Used Exclusively With Ocean Outfalls About 1,000 Ft. Long for Bathing Beach Protection

SEASIDE resorts on the northern New Jersey coast of the Atlantic protect their bathing beaches from sewage pollution by providing sewage-settling tanks and long ocean outfalls. One-story tanks have been used exclusively for topographical, foundation and scenic reasons. The first of these tanks was built at Asbury Park in 1905 and reconstructed in 1907. From 1908 to 1913, eighteen plants were built; in 1914-26, one; in 1927, one; a total of twenty in 23 years. Since 1925 additions have been made to six of these plants. Five old plants have been replaced by plants of improved design, while two new plants to replace old ones are now under construction. The following information regarding these tanks, the outfalls, and also on the pumping stations, now becoming common, is taken from a paper by I. Russell Riker, senior sanitary engineer, New Jersey


Typical Tank Submitted 1912
Typical Tank Submitted 1927 to Replace that Submitted 1912
Note:- While this is an improvement over the 1912 design the details are not recommended

OLD AND NEW TYPES OF SEWAGE-SETTLING TANKS ON NORTH JERSEY COAST

Department of Health, read in March of this year before the New Jersey Sewage Works Association.

Most of the earlier tanks were crudely constructed, with "too low a ratio of width to length," sometimes only one to one. Excessive baffling was provided, causing "cross-currents and high velocity." The earlier outlets extended from 500 to 1,000 ft. into the ocean and were of cast-iron, wrought-iron or steel pipe. Because steel pipe rusted, either cast-iron or wrought-iron is now used.

Design of the settling tanks has been largely standardized and the baffles for the most part have been eliminated. Pumping, rarely used in the early years of these tanks, has become common owing in part to the improvement in pumping equipment, thus giving more flexibility both in the design of the tanks and in the choice of sewer grades. It is considered preferable to pump the tank effluent to the outfall rather than the raw sewage to the tank.

The accompanying illustrations show in a general way the type of the earlier and present settling tanks used along the north Jersey coast. The plants are generally designed for ten years in advance, with provision for future extension. When pumping is employed, all sewage is screened (by means of coarse bars), even where the latest type of open propeller sewage pump is used. Duplicate pumps and a duplicate source of power are provided, with the equipment above ground in a building. Efforts are usually made to have the pumping station attractive. Sometimes it houses a public comfort station.

Two or more tanks are always provided, for convenience in cleaning and to meet seasonal fluctuations in the volume of sewage to be handled. They are designed to provide a theoretical detention period of eight hours, exclusive of sludge accumulation, which is based on 2 cu.ft. per capita. The ratio of width to length depends upon the number of the tanks. Where the number is three or less, "the ratio is usually made between one to three and one to five." The tank depth is at least 6 ft. and usually the bottoms are laid with a 2 per cent slope to a sump, generally located at the inlet end of the tank. Scum boards are provided at the inlet and the outlet ends of the tank. There rarely are any other scum boards or any baffles. The tank inlets are pipes, sluice gates or weirs; the outlets are weirs as long as the width of the tank. Outlet weirs are never submerged. Special weirs, in combination with a water-level recording device, are generally used to measure the sewage flow. Recent plans have included a Venturi meter, which is considered preferable to a weir. Tank ventilation, which is considered important, is sometimes provided through a hollow flagpole, with forced ventilation if considered desirable.

No sludge is discharged during the bathing season. Cleaning is usually done in the late winter or early spring, at high tide, by forcing the sludge through the ocean outfall. Any sludge washed onto the beach is carried away by succeeding high tides. Some plans submitted to the state health department have included glass-covered sludge beds on the roof of the settling tank, which, said Mr. Riker, "in my opinion will be the future means of sludge disposal along the shore."

It is expected that chlorination will be necessary before many years. Designing engineers are "providing for a chlorine detention tank in all new construction work."

Analyses indicate that the "new type of settling tank removes 60 per cent of suspended matter, whereas the old type never removed more than 10 to 40 per cent." Where the new type of tank is used there is "no evidence of objectionable sewage suspended matter" on the shore, and "suspended or coloring material" discharged through the outfall "is dispersed within a few hundred feet from the end of the outfall.

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## Extent of Flood Damage to Rutland Railroad

The 1927 report of the Rutland Railroad, recently made public, shows how extensively the road suffered from the New England floods. Of the total mileage of 413, the flood affected 263 miles to a varying degree. There were 356 separate washouts from 1 to 70 ft. in depth, aggregating 17.2 miles in length and requiring 150,000 cu.yd. of material to repair. Forty slides aggregating 10,000 cu.yd. covered a total of 1 mile of track. The cost of repairing flood damage is estimated at $750,000, besides a loss of revenue of $285,000 due to suspension of traffic.

# From Job and Office

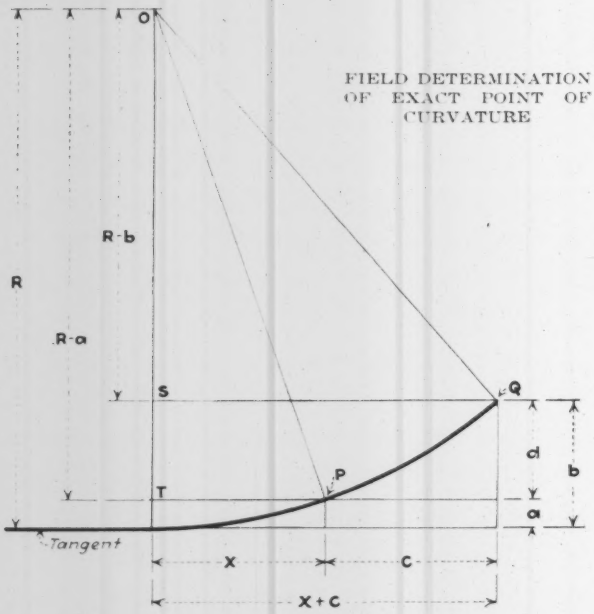
***Hints That Cut Cost and Time for the Contractor and Engineer***

## Locating Junction of Tangent and Curve Lacking Original Data

By C. C. Hubbell
*Norwalk, Conn.*

IN ENGINEERING work it is sometimes necessary to locate the exact point of intersection between a straight line and a curve with no information at hand regarding the original layout. The required point can be found easily by the use of the formula below.

Select two known points, $P$ and $Q$, on the curve and measure offsets $a$ and $b$ to the tangent. Let $b - a = d$. The distance along the tangent between the two offsets is



FIELD DETERMINATION OF EXACT POINT OF CURVATURE

$c$, and the distance from the first offset to the required point of intersection is $x$. Substitute the measurements in the formula.

$$x = \frac{ac \pm \sqrt{ab(c^2 + d^2)}}{d}$$

The negative sign applies when the point of curvature is between the two offsets; otherwise the positive should be used.

The derivation of this formula can be checked by obtaining the values for $R^2$ in the two right triangles $PTO$ and $QSO$, equating the two expressions, and solving for $x$.

## Making Concrete With Plaster Mixers

ON TWO jobs recently completed in Buffalo, N. Y., ordinary plaster mixers have been adapted to the manufacture of concrete. For the floors of a large school, B. Rebescher & Sons, Inc., averaged 3,000 sq.ft. of floor per day with a plaster mixer. The blades of the mixer were set out about $\frac{1}{8}$ in. from the drum so as to permit passage of the larger aggregate. Otherwise there were no changes made in the mixer. According to the Marsh-Capron Company, whose plaster mixer was used, an advantage in using the mixer for this type of work is that the concrete can be mixed very stiff. Similar use of a plaster mixer was made by the John W. Cowper Company in the building of a large store. Here not only was the concrete for the floors mixed with the plaster machine but the colored terrazzo was also prepared in it.

## Asphalt Cracks Often Due to Joints

By Jesse Henderson
*Cleveland, Ohio*

THE EXPERIENCE of eighteen years with asphalt work has convinced me that most of the cracks appearing in asphalt pavements can be traced to careless workmanship at the joint between hot asphalt and the cold pavement previously laid.

The average raker combs only the top of the asphalt, leaving that underneath just as it was shoveled in place. What he should do is to comb the material thoroughly, pack the joint with his rake, and then have the tamper compact it soundly. Following this, the smoother should fuse together the old surface and the new to make a water-tight joint. This last is usually done, but a good job on the surface is useless unless the entire joint is well made.

## Practical Record System for a General Engineering Office

By G. I. Gibbs
*Asheville, N. C.*

THE matter of records in an engineering office is a very important one. No matter how accurate and neat in appearance is the work that is put out by an engineer, it always leaves a bad taste in the mouth if he is not able to produce, on short notice, any drawing or set of notes wanted. Also, it is decidedly irritating and at times embarrassing not to be able to find what is wanted when it is wanted. A system of records which has been found to be very satisfactory is explained below.

Each page of all field books, whether loose-leaf or of the ordinary bound type, should show both the usual page number and a job number. The books or leaves should be bound consecutively for ready reference in the future. When loose-leaves are used it is convenient to bind all pages referring to a single job together so that none can become lost or misplaced.

A triple card index of all work done by the office is the next step. The first section is a numerical index, filed numerically; the second, the client index, filed alphabetically; and the third, the location index, also filed alphabetically (in a separate series). The regular 3x5-in. filing cards which may be purchased from any good bookstore or office supply house are very satisfactory for this purpose.

The numerical index (on white cards) is merely a chronological list of jobs. In addition to the name of the

client, it shows the date each order is received, a short description of the work, and its location. This information is filled in immediately on receipt of the order and occupies only one line per job. As there are ten lines on the standard card besides the top heavy line, this index is much smaller than either of the others. By using only the ten lines for this record, all the job numbers in a given ten appear on one card—that is, all the 40's are on one card, all the 70's on another, etc. The plan of numbering may be either that of using one series of consecutive numbers or a separate series for each year. The second plan mentioned has its advantages. When it is used, the last two digits of the year may be employed as the first two digits of the job number. For instance, all the job numbers used this year would begin with the figures 28; all last year, with the figures 27, etc. A glance at the number is sufficient to determine approximately how long a time has elapsed since the work was done.

The client index (on buff cards) is the main index and contains a separate card for each job. The job number is placed in the upper right-hand corner and the "name" on the first light line to the left. These are the two most important parts of the index. Very often a glance at the name will be sufficient to identify the job

2850. 3/20 Kinston, J.L. Lot Survey Marion St
2851. 3/22 Billings, M.S. " " Clyde St
2852. 3/23 Peters, L.T. Topog. River Rd.
2853. 3/25 Georges, A.C. Farm Survey Mocksville Rd.
2854. 3/18 Carthers, F.R. Sewer Line Happy Park
2855. 3/29 Conn Service Co. Bldg Loc. Brow St
2856. 3/2 Black, W.F. & Son Road Loc. High St.
2857. 3/2 Phillips, H.A. Lot Location Reta St
2858. 3/3 McPath, P. Landscape Plans Myrtle St
2859. 3/6 Stall, C.P. Plat from Deed Almond Rd

Job No. 2856
Name Black, W.F. & Son Order Recd. 3-2-28
Address 32 Walnut St. Work Started 3-3-28
Ordered by Tom Black Completed 3-10-28
Location High St. to Marietta Road
Description 4000' of Road & located. Rolling country. Wooded.
Notes 432-26 Plat Yes Report Yes
Charge $150.00 Billed — Paid 3-10-28.

Job No. 2856
Location High St. to Marietta Road
Name Black W.F. & Son
Description Road location
Date 3-3-28.

RECORD CARDS FOR A GENERAL ENGINEERING OFFICE
Top, numerical index (white); center, client index (buff); bottom, location index (blue).

and then the number locates the notes if they are filed numerically. "Ordered by" on the third line is used when a client is a company or partnership, to specify the individual who authorized the work. The "description" should be full enough to supply a basis for comparison with proposed work. For instance, if the job were a survey of a farm, the information should include the acreage, the kind of territory traversed, the number of lost corners replaced and similar information. Opposite "notes" on the next to last line should be entered the number of the field book and the page where the notes start. Opposite "plat" should be noted either "Yes" or "None." The same applies to "report." The last line not only gives an idea of about what a survey of a certain kind would cost but also constitutes a credit report to a certain extent. Opposite "billed" is entered the date the first bill is sent to the client for this job and opposite "paid" the date when he paid it. A comparison of the two readily shows whether or not he paid this particular bill promptly.

On the back of this card should be carried a list of all the drawings made in connection with the job. In addition to the ordinary title, each drawing should show the job number and a letter. The first drawing made is A, the second, B, etc. The back of the card might carry a record like this:

A—PP—Prel. Profile ..... File No. 86
B—DP—Prel. Alignment & Topog. ..... File No. 86
C—PP—Loc. Profile ..... File No. 86
D—DP—Loc. Alignment, etc. ..... File No. 86
E—PPP—Tracing, Alignment & Profile ..... File No. 53

The first column of this tabulation is, of course, the distinctive letter carried in connection with the job number by that drawing only. The second column indicates the material on which the drawing is made, as, for instance: DP—detail paper; TP—tracing paper; PP—profile paper; PPP—plan-profile paper; L—linen; etc. (In searching for a drawing among others, it is much easier to find if one knows what kind of paper to look for.) The third column identifies the drawing and the fourth shows where it is filed.

The location index (on blue cards) is an auxiliary index from which to locate a certain job should the name of the client be forgotten. For instance, being called on to locate a lot on Beulah Ave., one remembers that he made a survey in that same block three or four years ago. But for whom did he make it? Unable to recall the client's name, he turns to his location file, looks for Beulah Ave. and so locates his old notes, which perhaps carry a copy of a recorded plat showing the property in question. In this index, of course, the "location" is the main item. Therefore, it is shown on the first light line. As in the client index, the "Job No." shows in the upper right hand corner. The "name" of the client follows the "location" and then the "description," which may be very sketchy, just barely enough to identify the job positively. Opposite "date" should be carried the date on which the work was commenced. It is often necessary to make two or more of these location cards for one job, as when a lot at the intersection of two streets is surveyed.

In addition to this triple index, a map of the city hung on the wall of the office may show a red dot or a red mark just where work has been done. It is not necessary to show the nature of the work or any other information; just that work has been done in that particular place.

If further information is wanted a glance at the location index readily supplies it.

# Letters to the Editor

*A Forum for Discussion of Views of Engineers and Contractors*

## Permanence of Heat Treatment of Steel—The Eads Bridge Arch Ribs

Sir—In your issue of June 28, p. 1009, is contained a brief summary of the report rendered by a board of engineers which examined the Eads bridge and decided that it was unimpaired after 54 years' service. One statement printed in your summary is worthy of comment. It apparently was made by Prof. Leroy McMaster, head of the department of chemistry at Washington University, who made chemical analyses of borings from the chromium steel members. He writes: "Time may have destroyed all the benefits of heat treatment."

Such a remark might be dismissed as lay evidence rather than expert were it not that the same doubt has been expressed to the writer by a leading civil engineer. He said that he did not like to put heat-treated structural or alloy steel into bridges because he did not know whether the properties induced by heat treatment would be permanent.

Nevertheless, as bridges are built bigger and bigger, the need of structural material with higher physical properties, particularly high elastic limit and unimpaired ductility, is more and more pressing. The metallurgist would say immediately that the best way to improve carbon structural steel would be to add a moderate amount of such metals as manganese, chromium, nickel or vanadium, and subject the rolled sections or plates to a well-designed heat-treating operation. By "heat treating" he would mean a schedule of heatings and coolings at properly controlled times and rates—the equivalent of that which is given every automobile steering knuckle and crank shaft. But such material will not be accepted by the civil engineer as long as the latter has any doubts as to the permanency of the properties induced by such treatment.

Of course one cannot quote records of successful performance dating back centuries, because heat-treated steels have been used by engineers only in recent years. Bridges like the Eads bridge are themselves evidences of the permanency of the properties induced in low-carbon structural steel by addition of a little alloying metal and a simple heat treatment.

The only really old steel which exists today is in tools and swords. Of course, cutlery is made of a high-carbon steel and is not of the same grade as structural steel. Nevertheless it has all been hardened—that is, quenched and tempered—and consequently some light on the permanency of the effects of heat treatment may be had from an examination of ancient swords. A sword is hardened and tempered to a rather delicate point, and in the parlance of the physical chemist is in a much more "metastable" condition than heat-treated steels likely to be used in structures. Consequently, if there is any tendency to change with time, the microstructure and the physical properties of ancient blades should show marked deterioration. Fortunately Japanese scientists at the Imperial University have made a careful study of these points. Dr. Honda (a metallurgist of international reputation) concludes as a result of extended tests that the Masamune swords made some 600 years ago are superior to anything made today, in both original sharpness and durability. Fragments of a sword from an old tomb probably 1,200 years old show the expected microstructure of fine-grained martensite with no traces of its well-known decomposition products, even when examined at 1,000 diameters. The Shore scleroscope hardness of this fragment varies from 58 to 68. Eleven other very old swords were tested with the following results: Maximum hardness 83, minimum 53, mean 66 (all Shore scleroscope numbers). Since these results are within the same range as those which are found on much more modern blades, Professor Honda and his associates conclude that "Japanese swords found in old tombs do not undergo any change of structure (other than corrosion) during several hundreds of years, or even over 1,000 years." Evidently here are no signs of the internal decay hypothecated by Professor McMaster.

It might be pointed out that civil engineers have used successfully large quantities of steel in a condition which would be excluded from important stress-carrying parts by most mechanical engineers (who make no objection to using heat-treated steels in large quantity). I refer to the wire in suspension bridge cable. This is "work-hardened" to a high degree, and experience with non-ferrous alloys particularly shows that work-hardening is a common cause of spontaneous failure through "season cracking." Well-made bridge wire fortunately is immune from this trouble. Work-hardening, as far as we know, is also just as permanent as hardening by heat treatment (and when we say "hardening" we also mean "strengthening"). Thus, H. C. Boynton, metallurgist of the John A. Roebling's Sons Company, has tested bridge wire after nearly 75 years' service and concludes that "cold-worked iron installed 75 years ago has not lost its valuable physical properties since the bridge was erected."

New York, July 31, 1928. E. E. Thum, Associate Editor, *The Iron Age*.

## Thames Floods

Sir—Supplementary to the article on Thames floods in your issue of June 28, 1928, p. 1005, it may be of interest to note what was known of the causes of high tides in the Thames more than two centuries since. In the 1720 edition of Stow's "Survey," amplified by Strype, we find, on p. 31 of Book I, the following:

"Of the Overflowing of the Banks."

"The Thames overflowing its Banks, proceedeth from several Causes.

*"First.* From great Rains, whereby the fresh Waters raise up the River, and going down to the Sea are stopt by the Floods, whence they must needs swell above their usual Height. Of this there was a notable Example in the Year 1555, where by reason of Excessive Rains that had fallen, all St. George's Fields in Southwark, as also the Palace Yard, Even Westminster Hall, were overflown.

*Secondly.* Inundations of the Thames, may be caused by boisterous Northwest Winds, which generally cause very great Tides, not only in the Thames at the Mouth thereof, but on the Coast of Holland, Flanders, Picardy, and the Shores of England opposite to them. And this is, because the Wind doth with equal Force blow in the Tide of Flood at both ends of this Island, both Westwards and Northwards.

*"Thirdly.* There is another Cause of great Tides . . . ."

[Here follows an explanation of exceptionally high Spring Tides.]

The high tide of Jan. 7, 1928, which wrought so much damage, was exceptional only by a matter of some 11 in. of height. There had been for long past no adequate margin of safety. The proposed inquiry into North Sea tidal conditions, excellent in itself, need be no occasion for the delay of suitable safeguards. We do not know, and perhaps may never know, the highest water level of the future, but we do know that something must be done. At Horseferry Road, in Westminster, where the trouble was most serious, that something has already been achieved, and the new parapet wall, just finished, is now perhaps as much in excess of requirements as the old brick wall was in defect. This old wall was simply a parapet, wholly unfit to act as a water-retaining wall. On the night of the disaster, as the river rose, it overturned, allowing a rush of water across a road to houses having basements, in which many people were drowned.

London, England. July 17, 1928. W. W. Thorpe, Civil Engineer.

## Welding a Gasholder: Correction

The welding of the big gasholder at Albion, Mich., was done by welding machines using metallic electrodes and not carbon electrodes, as stated in the discription of this work in *Engineering News-Record* of July 5, p. 16.

# News of the Week

## Court Holds Albany Water Caused Case Of Typhoid Fever

### Appellate Division Sustains Jury Damage Verdict for Illness Due to Pollution

DAMAGES of $2,000 to a minor and of $1,000 to his father against the city of Albany, N. Y., on a claim that the minor contracted typhoid fever from the public water supply of that city in April, 1924, have been unanimously affirmed by the Appellate Division of the Supreme Court of New York State, thus upholding a jury decision in the State Supreme Court rendered in November, 1926. The pollution is held to have been caused by leakage through cracks in the cast-iron supply main, laid in the bed of the old Erie Canal between the filtration plant and the main pumping station. This main is now being replaced. Extracts from the decision (reprinted in full in *Health News*, the official organ of the New York State Department of Health) follow:

It is claimed that the disease had its inception in unwholesome water furnished by the city, and this condition arose through the negligence of those in charge of the water system in failing to purify the water delivered to consumers; and that the authorities neglected to give warning, although they had notice that dangers existed.

Beginning on April 7, the water was tested at the state laboratory by and under the supervision of Dr. Wachter, a chemist in the division of laboratories and research of the State Department of Health. These tests were made from the tap which was on the same system as that furnishing water to plaintiff's family. On nearly every day between April 7 and 23, colon bacilli were found in increasing numbers, indicating some definite source of pollution not eliminated by the filtration. About this time there was a sudden increase in gastro-intestinal diseases in the city. The officials in charge of the water department had notice of the defective condition of the conduit, the sudden pollution of the water, and the outbreak of diseases traceable to impure water, but the warnings were ignored. It was a time for prompt and decisive action. There were two possible sources of contamination—one by impure water passing the filters into the well, the other by introduction of polluted water into the conduit. The exercise of vigilance would have led to discovery of the dangerous condition, and reasonable diligence would have provided the remedy. It was possible, by greater chlorination before the water went into the clear water well, to eliminate all dangerous bacilli which had passed the filter; and there was a chlorination plant at the Quackenbush St. pumping station which would have removed the new pollution occurring in the conduit, but this was not put in use, at least during the first ten days in April. Common prudence would have suggested a notice to citizens that the water had become polluted and a recommendation that all water intended for human consumption should be boiled. But no preventive measures were taken until an epidemic had broken out.

To insist that the plaintiff must establish that the infection came from the city water by positive proof would be to require an impossibility. It is sufficient if it is shown by the best evidence available that the bacilli were introduced into his system by means of the city water, so that the jury may by reasonable inference reach a conclusion to that effect. This is not speculation, but a process of logical deduction.

The plaintiff gave proof excluding other sources of infection. The defendant's counsel in argument merely suggests that there are other possible sources, but there was no sufficient proof on its part of their presence or of the probability that such causes intervened to furnish the origin of the plaintiff's disease. The epidemic at this particular time including such a large number of cases would, under the circumstances shown, indicate a common origin.

About 80 other cases of the same kind are said to be pending.

## Lockwood Greene Engineers, Inc., Takes Over Old Firm's Work

Lockwood Greene Engineers, Inc., has purchased from Lockwood, Greene & Company, Inc., the entire business of its engineering division, including its appraisal department. The new concern is a Massachusetts corporation formed by men who for many years have been continuously associated with the engineering activities of Lockwood, Greene & Company, Inc. The new company will continue to maintain the present offices in New York, Boston, Spartanburg, Chicago, Charlotte, Atlanta and Montreal.

Lockwood Greene Engineers, Inc., will take over all contracts without change in its operating personnel and will continue to maintain the high standards of engineering always associated with the name "Lockwood Greene."

An association is maintained with Walter W. Cook and George F. Blount (formerly of the architectural department of Lockwood, Greene & Company, Inc.) under the name of Cook & Blount.

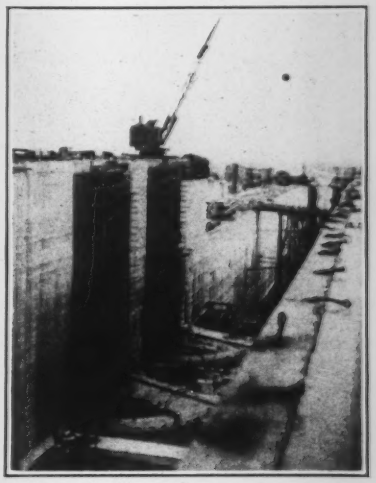
## Belgian Engineers to Inspect U. S. Power Plants

Robert Willems and Marcel Merlin, two engineers of the Ministry of Public Works of Belgium, have arrived in this country on a three-month inspection tour of American hydro-electric plants. Upon their return to Belgium they expect to be sent to the Belgian Congo.

## Crane, in Falling, Upsets Heavy Gate Of Welland Canal

### Crane Swinging End Post Into Place Overturns—Ten Men Killed by Fall of Crane and Gate

ONE of the most serious accidents in the history of the construction of the new Welland Canal occurred on Aug. 1, when one of two cranes working on the lock wall of Lock No. 6 placing the end post of one of the gates overturned and in falling between the lock wall and the gate upon which it was working upset the gate, causing it to fall across the canal lock chamber, striking the opposite gate and then collapsing upon the floor of the chamber. Six of the workmen were killed instantly, four subsequently died from injuries and about twenty-four other men were injured.



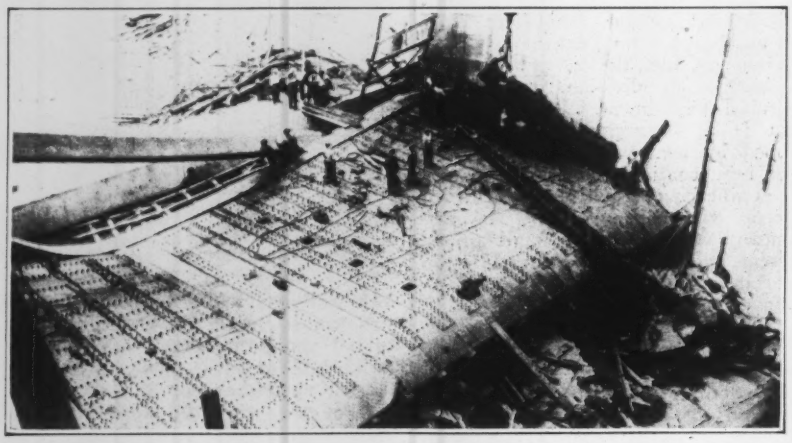
EAST CHAMBER, LOCK 6, WELLAND CANAL

Picture taken two weeks ago showing gates involved in accident. The cranes were operating from the track upon which the crane shown here stands.

The new Welland Canal closely parallels the present one between Lake Erie and Lake Ontario. Work upon it was begun before the war and it is expected that it will be completed in 1930. Seven locks, among the largest in the world, will replace the numerous small locks of the present canal. Lock 6 is the upper one of a flight of three twin locks over the escarpment near Thorold, Ont. At its north or lower end are two pairs of miter gates, one pair the regular service gates and the other a pair of guard gates. These gates are similar; each leaf is 82 ft. 6 in. high and weighs approximately 450 tons. At the time

WELLAND CANAL GATE OVERTURNED BY FALLING CRANE

Above: East chamber of twin lock No. 6, Welland Canal, looking south (upstream), showing at the right the standing service gate with the crane above and, in the middle foreground, the fallen guard gate. Below: The fallen guard gate with the fallen crane.



of the accident the Steel Gate Company was engaged in erecting the four gates at the north end of the east chamber of Lock 6. Both leaves of the guard gate were completed to the point that the framework was erected, the sheathing plates in place on the upstream side of the westerly leaf and the riveting started. The framework of the west leaf of the service gate had been erected and the sheathing plates were in place and bolted up on the upstream side, while only two lower horizontal girders of the east leaf were in place. The gates are assembled in a partly opened position. About forty men were riveting on the west leaf of the guard gate and seventeen men were working on the east leaf. Twenty-eight men were working on the leaves of the service gates.

This latter force was in the act of placing, with the use of two locomotive cranes, the end post on the miter end of the west leaf of the service gate, a member 82 ft. long weighing approximately 20 tons. The method used in placing the end post was as follows: One crane, a 30-ton machine with 50-ft. boom, stood on the lock wall about opposite the miter end of the gate. It was supported by outriggers. The other crane, a 25-ton machine, stood to the south of it on the lock wall, sufficiently far from it so that the end post could be raised from a horizontal position upon the lock wall between them. Since it had to travel forward, it could not use outriggers. In the placing operation, the end post, hung from equalizing slings, was swung out over the lock chamber and then the southerly crane moved forward toward the fixed crane to allow its end of the end post to descend into the lock chamber until the post came to a vertical position. It was during this operation that the southerly crane, while opposite the west leaf of the guard gate, for some reason still unknown to the canal authorities over turned and fell into the space between the lock wall and the guard gate, occupied by the erection scaffolding. In falling it wedged out the guard gate leaf, causing it to fall across the lock chamber and against the easterly guard gate. The crane operator jumped and escaped with minor injuries. The men who were killed or seriously injured were upon the scaffolding or upon the gates themselves.

The full weight of the end post came upon the fixed crane with the fall of the moving crane, but it was able to support it and swing it to a safe position across the canal, as shown in the accompanying illustration, without further damage. The crane which overturned had a lifting capacity of 25 tons.

The canal is being built by the Department of Railways and Canals of the Canadian government.

## Pasadena Plans Extension of Water-Supply System

Plans are being prepared by the city of Pasadena, Calif., for a domestic water-supply project which will involve the construction of a large gravity dam about 375 ft. high and 20 miles of conduit. The total cost is estimated at $8,000,000. S. B. Morris is chief engineer of the project, Louis C. Hill is consulting engineer, and Cecil E. Pearce chief designing engineer.

## Dallas Starts Work on River Levee Project

Work has been started on the building of about 25 miles of levee for the control of the Trinity River in the vicinity of Dallas, Tex., to cost about $6,500,000. The channel of the river is to be straightened, moved away from the city and confined in a flood channel from 2,000 to 3,000 ft. wide by the levee system. Much of the land inside the levees will be available for park and recreational use except during times of flood, while more than 10,000 acres of low, swampy bottom land will be made suitable for industrial and business use.

The contractor is the Trinity Farms Construction Company of Dallas. Meyers, Noyes & Forrest, of Dallas, and the Morgan Engineering Company of Memphis, Tenn., are the engineers. It is expected that the levee work will be completed in about two years, after which a number of other improvements made possible by the confinement of the river are contemplated.

## Polluted Wells and Springs Raise Pittsburgh Typhoid

An abnormal number of cases of typhoid fever in Pittsburgh, Pa., during July is attributed to the use of water from polluted wells and springs in the southern part of the city. It is believed that the pollution was augmented by heavy rains which washed privy contents down to the springs. Local and state health authorities agree in believing that the excess typhoid was not due to milk or to water from the city mains or those of the South Pittsburgh Water Company.

For July, 1928, 32 cases of typhoid were reported, compared with 12 the previous July and 77 for the entire year 1927. In June of this year, there were 7 cases of typhoid, against none in June, 1927. The heaviest typhoid months in 1927 were August and September, with 19 and 16 cases, making 35 of the 77 cases for the entire year. Up to Monday, Aug. 6, only 2 cases had been reported for the present month. Typhoid deaths in Pittsburgh in 1927 totaled 13, a rate slightly less than 2 per 100,000 for an estimated population of 665,000. For the first seven months of both 1927 and 1928, typhoid deaths totaled 4. All the foregoing figures include both resident and non-resident deaths. For July, 1928, non-resident cases were a less percentage of the total cases than for July, 1927.

Of the recent typhoid cases, 6 lived in a part of the city called "Seldom Seen," which district until the outbreak was supplied by local wells. Use of the wells was discontinued on the running, by the South Pittsburgh Water Company, of a temporary pipe line to the few houses concerned. Seven cases occurred on Climax St., also on the South Side, among people who took water from a spring since found contaminated. Access to the spring has been shut off and the water piped to a sewer. A number of other cases used well or spring water.

Dr. R. G. Burns is director of health of Pittsburgh. P. E. Marks is superintendent of the bureau of infectious diseases of the Department of Public Health.

## Portland Cement Association Accused of Unfair Methods

A complaint issued by the Federal Trade Commission on July 31 charges the Portland Cement Association, an organization representing 90 manufacturers who are said to make and sell 95 per cent of the cement manufactured in this country, with unfair methods of competition.

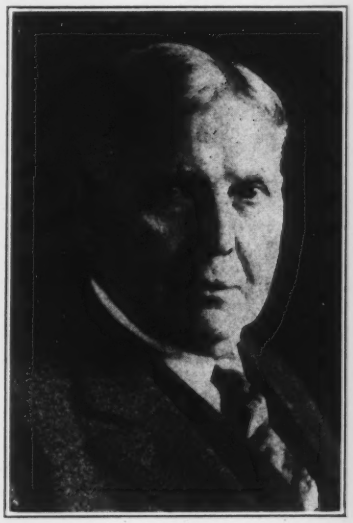
The specific charges relate to methods claimed to have been used against the American Vibrolithic Corporation. The complaint states that the Portland Cement Association, through its agents and representatives, has sought to influence those who control the making, awarding or approval of road-construction contracts by statements, oral, written and printed, falsely disparaging and discrediting the vibrolithic method; and that it has addressed to engineers, public officials and property owners false, misleading and deceptive statements regarding the expensiveness, durability and efficiency of the vibrolithic type of concrete paving as compared with other pavements.

The Federal Trade Commission has set Sept. 19 as the date for a hearing.

## General Potter, Former Head of Mississippi Work, Dies

Brig. Gen. Charles L. Potter, Corps of Engineers, U. S. Army (retired), died at St. Louis, Mo., on Aug. 6, following an operation for intestinal trouble.

General Potter was born in Lisbon Falls, Me., Jan. 24, 1864, and entered the U. S. Military Academy in 1882. Upon graduation in 1886, he served with



Brig. Gen. Charles L. Potter

the Fifth Cavalry for about a year, when he was transferred to the Corps of Engineers. From that time his service was with the Engineer Corps, chiefly on the Mississippi River, a service which culminated in his serving as president of the Mississippi River Commission from March, 1920, until his retirement in June of this year.

General Potter's service on the river began upon his return from the Philippine Islands in 1899 to take charge of the third Mississippi River Commission district at Memphis and had been almost continuous since that date. In 1910 he was appointed secretary of the Mississippi River Commission, a position which brought him into contact with work on the entire river. Subsequently, for the years 1912 to 1915, he served as district engineer in the St. Paul district, in charge of work on the Mississippi above St. Paul.

An extended account of General Potter's service upon the Mississippi River was given in our issue of June 28, 1928, p. 1019.

## Request Approval for Extension of Texas Railroad

The Chicago, Rock Island & Gulf Railway has requested the approval of the Interstate Commerce Commission of a plan to acquire and operate a line of railroad from Amarillo to Stinnette, Tex., part of which line has been constructed for 58 miles from Amarillo. It is desired to proceed immediately with the extension 33 miles to Gruver, Tex., and as rapidly as possible to extend the line to the boundary between Texas and Oklahoma.

## Agreement Ends San Gabriel Dam Controversy

Controversy over the $25,000,000 dam which the Los Angeles County Flood-Control District proposes to build at the Forks site in the San Gabriel River has been ended by an agreement signed by opposing interests, including two taxpayers' and citizens' associations and more than a score of water companies and municipalities. "All parties are agreed," the document reads, "that it is to the best interests of said (Flood-Control) District that said dam should be built at as early a date as possible."

Provided no more than the $25,000,000 originally voted for the structure shall be expended upon it from bonds or other public moneys, the agreement binds signatories to "in no way whatever oppose the building of the dam." In case additional funds should be required for any reason they are to be "furnished by local district assessment bonds or otherwise provided by those persons or corporations and others interested."

In view of this agreement and since plans and specifications were drawn up many months ago, it is believed that the call for bids will be announced some time during August. The present program, evolved from the high dam-low dam controversy contemplates a dam 432 ft. high to store 240,000 acre-ft. The structure would be 2,400 ft. long on the crest and is estimated to involve 1,600,000 cu.yd. of excavation and 4,250,000 cu.yd. of concrete. It is the so-called "high dam" as described in the original bond issue approved by the voters in 1924.

## Work Started on Model Town

The building of a model town planned to meet the problems of the motor age has been started at Radburn, N. J., about 17 miles from New York City. A $4,000,000 construction program has been planned for the first year, providing for the erection of a large office and business building, 300 small houses and an apartment building. In addition, the work includes the grading and paving of streets, laying water mains and a drainage system. The ultimate development will represent a total value of $60,000,000. The planning of Radburn was described in *Engineering News-Record*, Feb. 16, 1928, p. 293, and March 15, 1928, p. 426.

## Henry J. Burt, Structural Engineer, Is Dead

Henry Jackson Burt, of Chicago, consulting engineer prominent in structural engineering, died at his home in Wheaton, Ill., on July 28. Mr. Burt was born in February, 1873, at Urbana, Ill., and was graduated from the University of Illinois in 1896. During 1896-98 he was in the New Orleans office of the Gillette-Herzog Manufacturing Company, a Minneapolis structural steel and bridge concern. In 1899 he was resident engineer on construction work in Iowa for the Chicago & Northwestern Railway; in 1900, chief of party on surveys for Chicago track elevation of the Chicago & Western Indiana Railroad, and in 1900-01, assistant professor of civil engineering at Iowa State College. In 1901 he went to the American Bridge Company and became its centracting manager, first at Salt Lake City and then for six years in charge of the office at Denver, Colo. In 1911 he was engaged as chief structural engineer by Holabird & Roche (now Holabird & Root), Chicago, architects, specializing in large buildings. During the World War period, 1917-19, he was with the construction division of the army, in charge of plans for emergency construction, being appointed a major in the Quartermaster Corps. Later he was made lieutenant colonel in the Officers Reserve Corps.

After the war Mr. Burt returned to practice as a consultant in civil and structural engineering. He specialized in heavy building construction, both foundations and superstructure; also in the repair and reinforcement of existing buildings and in the adjustment of disputes and litigation relative to buildings. Among notable large Chicago buildings which he designed as structural engineer for Holabird & Roche were the Sherman, Palmer and Stevens hotels, the Chicago Methodist Temple, the Tribune Building and the Roanoke Tower Building. Several of these structures have been described, with his assistance, in *Engineering News-Record*, and its 50-year jubilee issue of April 17, 1924, contained a paper by him on the "Growth of Steel Frame Buildings." Mr. Burt was a member of the American Society of Civil Engineers, American Society for Testing Materials, and past president (1917) of the Western Society of Engineers.

## Philadelphia Subway Opens Soon

The new Broad St. subway in Philadelphia will begin operation on Sept. 1, when regular train schedules will go into effect. The line has been leased for a three-month trial period to the Philadelphia Rapid Transit Company.

# WASHINGTON NOTES

By Paul Wooton
*Washington Correspondent*

### Wide Scope to Boulder Dam Inquiry—Mississippi Report Due Soon—Foreign Materials

ASSURANCES have been given that the Boulder Dam Commission will not confine its studies to the reports of the Reclamation Bureau. Consideration is to be given to all existing reports by responsible engineers which have a bearing on the Boulder dam project. With both its Washington and its Denver offices furnished by the Bureau of Reclamation, some fear has been expressed that there would be little opportunity to consider reports and opinions from other sources. It may be said, however, that steps already have been taken by the commission to secure full information as to the views held by engineers in other bureaus and of engineers not in the government service. In this connection it is also pointed out that one of the chief purposes of the study is to check the cost estimates of the engineers of the Reclamation Bureau and to examine other fundamental data on which their conclusions were based. There also appears to be no ground for apprehension because of the limitations imposed in the resolution authorizing the study. It is pointed out that a report involving all facts pertinent to the economic feasibility of the project gives all the latitude necessary to a very complete set of findings. A second meeting of the commission will be held in Denver on Aug. 13.

### Building New Barracks

Rapid progress is being made with the building program for the Marine Corps at Quantico, Va. Under the supervision of the Bureau of Yards and Docks, three 500-man barracks now are under construction. They are to be completed by Feb. 1, 1929, and constitute the initial step in a $7,000,000 program. Within a few weeks contracts are to be let for the central heating plant, the motor transport building, apartment houses for officers, a storehouse, the commissary and the bakery. Plans and specifications for those buildings were recently completed in the civil engineering section of the Bureau of Yards and Docks. The central heating plant will be housed with the power equipment, which is designed to burn pulverized coal.

### Mississippi Board Meets

Consideration of the engineering differences between the reports of the Army Engineers and the Mississippi River Commission was begun in Washington on Aug. 6 by the board of three set up for that purpose by the flood-control act. Prompt determination of the questions involved is expected. Opinion to the effect that an intelligent report could not be rendered in so short a time does not agree with the views of John F. Stevens, it is pointed out. In his testimony before the Senate committee he stated that 60 days of intensive study is all that would be required "to harmonize these very vital differences."

Special studies are being made by the Corps of Engineers of all available data pertaining to velocities in New Orleans harbor. This information is to be laid before the board in connection with its study of the advantages and disadvantages of a spillway below New Orleans, as well as above that city. The work of the board, it was stated, has been expedited greatly by the unexpectedly large amount of mapping which it is found the Mississippi River Commission has done during recent years.

### Use of Foreign Materials

The Bureau of the Budget has adopted recommendations of the interdepartmental board of contracts and adjustments designed to impose more restrictions against the use of foreign materials and supplies in governmental construction work. In accordance with the adoption of these recommendations, the following paragraph has been added to the standard form of instructions to bidders on government work:

> Preference will be given to articles or materials of domestic production, conditions of quality and price, including duty, being equal. Unless otherwise stated in the bid, it will be understood that domestic articles or materials only will be used, and the use of foreign articles or materials will not be permitted unless (1) they are of better quality, or (2), being equal in quality, will be furnished at lower cost to the government, or (3) domestic articles or materials are not available.

At the insistence of the Associated General Contractors, who felt that lack of a definite understanding as to what is meant by the term domestic articles might be confusing to contractors, the following definition was added:

> The term domestic article or material in this connection means articles or materials manufactured or assembled in the United States or its possessions.

In the opinion of Major E. W. Cushing, counsel for the Bureau of the Budget, these new provisions concerning federal construction approach, as nearly as the present law allows, the purport of the bill introduced at the last session of Congress by Representative Wood of Indiana. Major Cushing stated that the greatest change over the former policy in favoring American materials is contained in the wording, "unless it is otherwise stated in the bid, it will be understood that domestic articles or materials only will be used." The language was not so definite before; the instructions to bidders only reminded contractors that American goods should be favored. Major Cushing pointed out that it is significant that under the new provisions, now operative, contractors will be required to extend some of the benefit of the saving to the government where cheaper foreign goods are used. Just how much benefit the government will receive in such cases will have to be determined by special agreements in each case between the governmental agency in charge of the work and the contractor.

## Engineering Societies

### CALENDAR

ANNUAL MEETINGS

AMERICAN WATER WORKS ASSOCIATION, Central Section, Pittsburgh, Pa.; Annual Meeting, Huntington, W. Va., Aug. 23-24.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Montreal, Canada, Sept. 18-21.

NATIONAL SAFETY COUNCIL, Chicago; Annual Meeting, New York City, Oct. 1-5.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Fall Meeting, San Diego, Calif., Oct. 3-5.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

THE ENGINEERS CLUB OF BALTIMORE has been invited by the Baltimore Association of Commerce to make an inspection trip of the port of Baltimore on Aug. 10. The municipal boat "Latrobe" will be used.

THE DULUTH ENGINEERS' CLUB, at a special meeting on Aug. 6, heard H. T. Plumb, of the General Electric Company, speak on "The Astronomy of the Atom."

THE CANADIAN GOOD ROADS ASSOCIATION has announced that its annual convention will be held at Regina, Sask., Sept. 25 to 27. An unusually large attendance from all parts of Canada is expected. The secretary of the association is George A. McNamee, New Birks Building, Montreal.

THE SECOND ANNUAL OHIO CONFERENCE ON SEWAGE TREATMENT will meet in Marion, Ohio, on Oct. 31.

## Personal Notes

H. E. STEVENS, chief engineer of the Northern Pacific Railway, has been appointed vice-president in charge of operation. He has been with the Northern Pacific since 1904 and has been chief engineer since 1916.

Major F. S. SKINNER, formerly on duty at the Army War College in Washington, is now district engineer at Providence, R. I. He relieves Col. S. A. Cheney, district engineer of the Boston district, who has also been acting as head of the Providence district.

MARTIN A. BRENNAN, assistant engineer, city engineer's office, Syracuse, N. Y., has resigned, effective Aug. 1, to accept the position of deputy city engineer of Rome, N. Y.

GEORGE H. DIASSELLISS, construction engineer for the United States government, has been assigned as engineer in charge of construction of the Donora, Pa., post office. Under the supervising architect of the Treasury Department he recently completed the post office projects at Chamberlain, S. D., and Elgin, Ill.

MORTIMER E. COOLEY, past president of the American Engineering Council and head of the college of engineering and architecture at the University of Michigan, has retired from his university work. He will be succeeded by Dean H. C. Sadler.

Lieut. Col. P. S. BOND will relieve Col. J. F. Woodruff as district engineer of the third New York district. Before being sent to New York, Colonel Bond was engineering instructor at the infantry school at Fort Benning, Georgia. Colonel Woodruff will be assigned to duty at Fort Leavenworth, Kansas.

H. T. WARE, V. E. Ware and R. A. Ramey announce the formation of the general contracting firm of Ware Ramey Company, with offices at El Paso, Tex.

F. C. RICHARDS, for the past five years superintendent and engineer on road and bridge construction near Olean, N. Y., is now in charge of road and bridge work at New Lebanon, Pa.

Lieut. Comdr. H. F. BRUNS, formerly public works officer of the ninth naval district, Great Lakes, Ill., has been assigned to duty in connection with public works development at Pearl Harbor, Hawaii.

WALTER M. SMITH, who has been chief designing engineer of the Division of waterways, department of purchases and construction, State of Illinois, for several years, has been appointed assistant chief engineer of that division.

W. W. WILSON, resident engineer for the Florida Highway Department on route 28, has accepted a position with the Arkansas Highway Department.

WEBSTER L. BENHAM, president of the Benham Engineering Company, consulting engineers, of Kansas City, Mo., announces that the main office of the company has been moved to Oklahoma City, Okla. A branch office will be maintained in Kansas City.

G. V. MIDDAUGH, recently with the Illinois State Highway Department, is now with the structural engineering department of the Western Gas Construction Company, of Fort Wayne, Ind.

S. C. ELLS, engineer in the Department of Mines, Ottawa, Canada, who has been actively engaged for the past ten years in the development of the bituminous sand deposits at Fort McMurray, Alberta, will sail for England shortly in order to investigate asphalt deposits in Europe.

Lieut. Col. W. D. A. ANDERSON has been assigned to duty as district engineer at Mobile, Ala., relieving Major Thomas H. Emmerson. Prior to this assignment, Colonel Anderson was on duty at Fort Humphries, Virginia. Major Emmerson will go to San Francisco to assume charge of the second San Francisco district.

JAMES GILBERT has resigned as engineer in charge of the Alouette-Slave Lake hydro-electric plant, in British Columbia, and has been appointed chief engineer of the Ghost-Bow River development for the Calgary Power Company.

Major P. C. BULLARD has been assigned to duty as engineer for the Duluth, Minn., district, relieving Major R. W. Crawford, who is at present holding that position. Major Bullard until recently was assistant military attaché at Paris. Major Crawford will be sent to Fort Leavenworth, Kansas.

FRANK KANE, formerly with the Gary Engineering Company, of Gary, Ind., is now map draftsman, computer and transitman with the Trenor Land Company, Inc., of New Rochelle, N. Y.

DAVID C. JOHNSON has been elected president of the New York Steam Corporation, to succeed James D. Hurd, who died recently. Mr. Johnson is a native of Brooklyn, N. Y., and is a graduate of Stevens Institute of Technology.

Major RAYMOND F. FOWLER, formerly in charge of the Providence, R. I., district, is being sent to New Orleans as engineer for that district. He will relieve Capt. Louis A. Pick, who has been assigned to duty with the R.O.T.C. unit in Texas.

## Obituary

ERNEST L. COOLEY, who had been for more than 30 years with the Sanitary District of Chicago, died on Aug. 4 at Canandaigua, N. Y., while visiting his brother. He was 72 years old. Mr. Cooley's design of a dam for use in controlling high water earned a gold medal at the Paris Exposition in 1903. He was a brother of Mortimer E. Cooley, dean of the college of engineering and architecture of the University of Michigan, and of the late Lyman E. Cooley, well known for his work in connection with the Chicago Drainage Canal.

JOHN R. STEWART, superintendent of equipment of the Florida State Road Department, was killed on July 17 when an automobile in which he was riding was struck by a railroad train near Columbia, S. C. Mr. Stewart had been with the highway department for a number of years as project engineer, division engineer and, finally, as superintendent of equipment.

CARLTON R. CONOVER, 50, Denver contractor who had been engaged in railroad and irrigation work, died on July 24. He went to Denver from Hackensack, N. J., about 25 years ago.

# Construction Equipment and Materials

## High Early Strength Developed by New Portland Cement

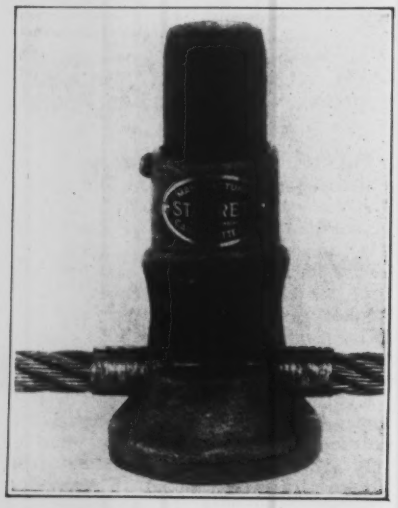
A new portland cement developing a high strength in 24 hours has been perfected by the International Cement Corporation under the trade name of Incor Cement. This new product is a true portland cement containing no admixtures of any kind and requiring no special mixing or placing methods.

For five years the technical and scientific resources of the International Cement Corporation have been concentrating upon the development of this new process; first in the laboratory and then upon a quantity production basis. Then followed exhaustive field tests under the direction of Prof. Duff A. Abrams, director of research of the corporation. The cement has already been proved successful by actual use on many jobs throughout the country. Incor Cement was used in the lining of the Moffat tunnel in sections requiring an early-strength concrete to withstand some of the high pressures encountered. Many cities have used this cement for pavement repairs where a minimum tie-up of traffic was desired. Precast concrete piles using this cement have been driven seven days after casting, without showing signs of cracking.

The corporation is now prepared to furnish this new cement to the construction industry throughout the territory east of the Rocky Mountains.

## Cutting and Holding the Ends of Wire Rope

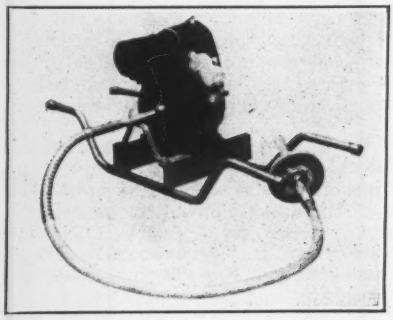
By the use of a cable cutter manufactured by the W. D. Starrett Metal Cutting Products Company, Alameda, Calif., and distributed by Horace Hills, 533 Market St., San Francisco, it is possible to eliminate the use of wire in seizing the ends of cut wire rope. The cutter is so designed that it will cut any size cable up to 1 in. in diameter and leave both of the cut ends incased in a steel band, all in one operation. One cut puts the seizing on both ends at the same time. The band is a thin sheet of pliable steel indented with a groove and lock seam at one end and is made in various lengths and sizes to fit different cables. Besides eliminating the danger of loose ends to cause injuries, the steel-band seizing allows the cable to be passed through any socket or opening of its own size. The cable cutter shown in the accompanying illustration is 6 in. high and 3 in. in diameter at the base and weighs 7 lb. complete.



## Portable Grinder and Finisher Driven by Gas Engine

A gasoline engine-driven grinder, cutter and finisher in a portable unit weighing 176 lb. is being built by the Stow Manufacturing Company, Inc., Binghamton, N. Y. The engine develops 2.2 hp. with an adjustable speed from 1,400 to 2,200 r.p.m.

The unit may be equipped with any kind of grinding or cutting tool to suit any need. It is of particular use in isolated cases especially where electricity is not obtainable. Some of the attachments listed by the manufacturer are rail grinders, concrete rubbers, sanding disks, rotary files, wire scratch brushes and abrasive grinding wheels.

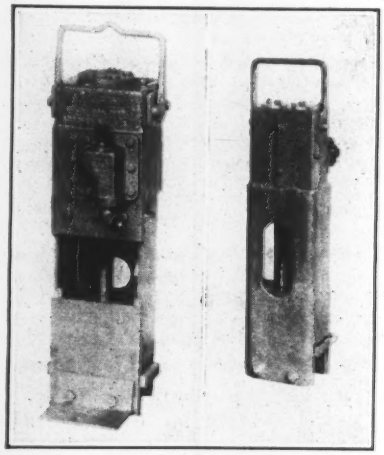


As shown in the accompanying illustration, the unit consists of the engine mounted on a portable frame, a flexible shaft of any desired length with a chuck holding any of the required attachments.

## Air Hammers for Driving Wood Sheetpiling

Two light-weight heavy-duty air hammers, designed especially for driving wood sheetpiling, are offered by the Union Iron Works, Inc., Hoboken, N. J.

The Union midget hammer, size 9, is for 2-in. wood sheeting, and weighs only 97 lb. Striking more than 550 blows per minute, this hammer uses only 32 cu.ft. of air per minute at 90 lb. pressure. The hammer is constructed with a symmetrical continuous steel frame with no exposed valve mechanisms or working parts. The Union midget is lubricated by two self-contained oil reservoirs with no outside oil cups. The bottom jaws of this size hammer are set for 2-in. wood, but an extra removable filler piece is supplied so that 3-in. wood sheeting can be driven when within the range of this weight hammer. The manufacturers claim that it is truly a one-man hammer.



UNION JUNIOR AIR HAMMER —FRONT VIEW

UNION MIDGET AIR HAMMER —REAR VIEW

The Union junior hammer, size 8, weighs 220 lb., strikes more than 450 blows per minute and uses but 40 cu.ft. of air per minute at 90 lb. pressure. This size hammer is designed for 3-in. wood sheeting and is essentially a two-man machine. The top section is a one-piece casting containing the cylinder, valves and valve gear. The jacket is of heavy steel construction securely attached to a cylinder block. There are no exposed valve mechanisms and working parts.

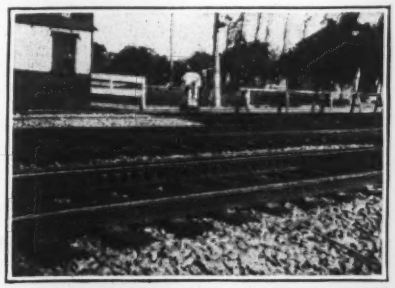
The striking parts of the Union junior and midget hammers consist of a piston and rod, and a ram. The two hammers are shown in the illustration.

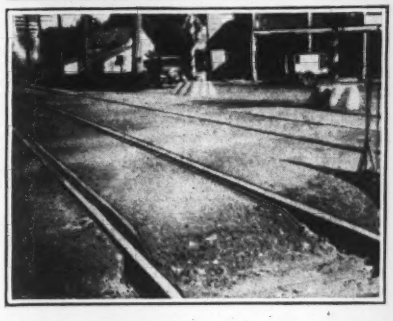
## Steel Flangeway Rail Guard Protects Railway Crossings

The Lebanon Steel Foundary, Lebanon, Pa., has recently developed a new type of steel flangeway guard for use in paved streets and at highway grade crossings, which is designed specifically to overcome the disadvantages of a flangeway guard in direct contact with the track rail. This guard, which is manufactured in normalized electric furnace cast steel, is of a modified channel section, and is made up in 4-ft. lengths which are keyed together to form a guard of any desired length. The flangeway guard is installed entirely independently of the running rail and is thereby not seriously affected by the vibration and undulation set up in

the rail under load. By preventing track vibration from reaching the paving, the life of the pavement is materially lengthened.

The guard sections are fastened in place by spikes driven into the ties, spike holes being provided at intervals of 6 in. along the lower flange of each section.





Additional anchorage for the guard is provided through the use of special braces, which not only assist in holding the guard in place but also act as keys to hold the separate sections together in correct alignment.

Holes in the web section of the guard insure a perfect bond with the paving. The guards are made up to suit any height of rail and are adjustable for any variations in tie width or tie spacing. Special flange sections 18 in. long used at the end give the guard a finished appearance, as can be seen from the accompanying illustration. The two illustrations show the guard installed before and after the paving is placed.

### Control for Automatic Welder Eliminates Arc Crater

For use with its automatic arc welding head, the General Electric Company, Schenectady, N. Y., has developed a control equipment which stops the feed of electrode wire a short time before shutting off the welding current at the end of the weld. This is claimed to do two things: First, it clears the electrode from the weld, and second, it fills in the crater which is inevitably left at the end of the weld when the arc is cut off short.

The General Electric control panel is governed by a "start-stop" push button station. When the end of the weld is reached, the operator pushes the "stop" button, which opens the auxiliary contactor. This in turn stops the electrode motor and opens the magnetic clutch circuit, thus stopping the wire feed. The fact that the line contactor remains closed for a short time because of the action of a time-delay relay allows the arc to burn back the electrode sufficiently to clear the weld and also to fill in the crater. The time-delay relay then opens and in turn opens the line contactor, which stops the travel motor by opening the travel relay.

## Business Notes

J. M. PAGE has been appointed Southern Branch manager of the Asphalt Association, with headquarters at 435 Whitney-Central Bank Building, New Orleans, effective Aug. 1. Mr. Page succeeds W. H. Rhodes, who recently resigned to accept a position with the New Orleans Refining Company. The territory covered by the Southern Branch at New Orleans embraces the states of Texas, Arkansas, Oklahoma, Louisiana, Mississippi and Tennessee. Mr. Page was formerly State Highway Engineer of Oklahoma (1924-27) and prior to that was engineer in the federal Bureau of Public Roads.

AN AGREEMENT has been signed whereby the controlling interest in the National Cast Iron Pipe Co., of Birmingham, Alabama, manufacturer of cast iron water and gas pipe, will be acquired by James B. Clow & Sons, of Chicago, operators of two cast iron pipe plants in Ohio and a plumbing and gas fixtures manufacturing plant at Chicago. The National company will retain its corporate identity. No change in officers or policies has been announced.

THE T. L. SMITH COMPANY, manufacturer of concrete mixers and pavers, has appointed A. J. Gerlach advertising manager. Mr. Gerlach was formerly with the Sterling Motor Truck Company.

THE HEIL COMPANY, of Milwaukee, Wis., announces the appointment of two new distributors for its products: Stiles-Murray, Inc., of Des Moines, Iowa, and the Omaha Standard Body Company, of Council Bluffs, Iowa. The former is a new firm formed by R. E. Stiles and E. F. Murray, both with long experience in the truck field, while the latter already operates a factory in Council Bluffs.

THE WAGNER ELECTRIC CORPORATION, St. Louis, has transferred Fred Johnson, heretofore in charge of its St. Louis sales office, to Los Angeles, Calif. Mr. Johnson will be in charge of the branch office there. Alex L. Miltenberger, formerly Pacific Coast manager with headquarters at San Francisco, will be branch manager of the St. Louis office.

W. H. REEVES, vice-president and general manager of the Layne-Southeastern Company, St. Petersburg, Fla., is now associated with Layne & Bowler, Inc., Chicago, Ill. R. R. Schweitzer has succeeded Mr. Reeves, with his principal office at 212 S.A.L. Building, Norfolk, Va. The St. Petersburg office is discontinued and the Florida office is in charge of Y. C. Carmichael, 4711 French Street, Jacksonville, Fla.

JAEGER MACHINE COMPANY, Columbus, Ohio, announces that the French Government has recently purchased 85 Jaeger mixers, 50 of them being of the 14-S size equipped with extension track loaders. The week previous an order for two carloads of Jaeger mixers had been received from the Soviet Government for shipment to Russia.

THE NATIONAL LUMBER MANUFACTURERS ASSOCIATION has opened a district field office at Memphis, Tenn., to serve the Southern district. Donald R. Brewster, formerly of the Chicago district office, has been made manager.

## Manufacturers and Trade Associations

### CALENDAR

ANNUAL MEETINGS

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; semi-annual meeting, Buckwood Inn, Shawnee-on-Delaware, Pa., October 1-3, 1928.

## New Publications

*Tractor Power*—THE CATERPILLAR TRACTOR COMPANY of San Leandro, Calif., and Peoria, Ill., has published four well-illustrated booklets, entitled "Caterpillar" Power for (1) Factories, (2) Railroads, (3) Mines and Quarries, (4) Public Utilities. Each booklet describes the use in all parts of the world of tractor power in the particular field mentioned by the title. Many interesting and unusual applications of the use of tractors are illustrated with a brief description of the conditions encountered. The booklets were compiled from actual jobs encountered in the field of 25,000 Caterpillar tractor users throughout the world.

*Motor Rollers*—GOOD ROADS MACHINERY COMPANY, INC., Kennett Square, Pa., devotes a new 8-page catalog to illustrations and descriptions of its Senior model roller and scarifier using a McCormick-Deering tractor mounted within the frame. The roller is similar to the company's Junior roller, which uses a Fordson power plant.

*Buckets*—OWEN BUCKET COMPANY, Cleveland, Ohio, has published a new catalog embracing its complete new line of buckets, giving complete information regarding weights, capacities, dimensions, etc. In addition to this, the catalog gives recommendations for the best type of Owen bucket for particular uses.

# The Business Side of Construction

## July Public Bond Sales at Lowest Point Since 1923

### Probable, However, That New Offerings Meeting New Level Will Be Well Received Later

FOR the first time this year the monthly total of state and municipal bonds has fallen below $100,000,000, and the July value of $69,890,000 is the lowest for that month since 1923. This is, of course, the dull season, which usually extends to September 15, due principally to the fact that many large investors are out of town. Despite this annual dullness, however, one large investment house states that "there has always been an expectancy during the month of June that the July business would be good because of reinvestment of funds received through July 1 maturities and July 1 calling of bonds, as January and July are the two months which seem to be favored for both maturing and calling of bonds. This expected good business in July has rarely occurred."

The past June and July, and now August, have been unusually dull months, both with respect to volume of sales and prices. The principal reason given is the high money rates prevailing, due to the action of the Federal Reserve Bank in raising the rediscount rate in an effort to curb further expansion in credit through brokers' loans. This action, by the way, has failed to result in the customary contraction of speculation. This excessive speculation is another reason for quiet in the public bond market. Widespread interest in common stocks has absorbed a great deal of investment funds which ordinarily go into bonds. A third explanation is that municipal bonds attained a price level during the first few months of 1928 due to low money rates that were too high to be maintained. The ease with which dealers could carry large amounts of bonds at low money rates caused competitive buying at public sale, which forced prices to a high level.

The first reason given for this summer's slackness is probably the chief reason. The banks of the Federal Reserve system have tried to curb excessive speculation in stocks. The banks themselves have complained of the enormous decrease in deposits. Another reason, given by another large investment house, is that the time may be near when there is a possibility of large losses for the inexperienced speculator. Tightening money has resulted in interest rates hovering around 7 per cent. The natural result is that banks and large investors have loaned their funds at 7 per cent rather than buy municipal bonds. Another result was that banks called or raised interest on loans to bond houses on their holdings of municipals, causing some of the houses to sell at lower prices.

It is interesting to note that the price decline has extended to municipal bonds in New York State, which are exempt from state income tax. City of Yonkers bonds that were offered on a 3.90 basis a few months ago have recently been offered privately at 4.25. New York State bonds that were 3.65 to 3.70 now closely approximate 4 per cent returns. In the general market municipals that were at a 4 per cent basis can be obtained freely at 4.25 per cent or better, depending on the size and credit of the state or city. In this connection it should be stated that the decline in the bond market has not been confined to municipals, but has taken place in railroad, public utility and industrial issues. A favorable factor is that there has been considerable purchasing on the part of insurance companies, the first in a number of years, of tax exempt bonds due to a recent decision of the court allowing such insurance companies to consider income derived from tax exempt bonds.

Both investment houses quoted in this article believe that a large offering of bonds finds greater favor than a small offering. The large offering not only attracts larger and stronger groups but it also attracts buyers from banking houses that have had little experience in handling public bonds.

With respect to the future, one of these houses is of the opinion that there has been somewhat of a shift back from stocks or equities to bond investments. The time is approaching when industry will need capital and when the federal government will need financing; it would therefore seem that money will have to decline in order to aid both industry and the government. With Labor Day the vacation period ends, and industrial operations usually increase as business settles down after a summer holiday. Finally, bonds have declined to a point where the income return is considerably more liberal than that prevailing for a number of months. It is therefore probable that new offerings that meet the new investment level and are adjusted to present market conditions will be well received this fall.

### E. N.-R. Index Numbers

| Cost | | Volume | |
|---|---|---|---|
| **Aug. 1, 1928** | **207.29** | **July, 1928** | **286** |
| July 1, 1928 | 206.65 | June, 1928 | 308 |
| Aug. 1, 1927 | 205.50 | July, 1927 | 252 |
| Average, 1927 | 206.24 | Average, 1927 | 263 |
| Average, 1926 | 208.03 | Average, 1926 | 228 |
| 1913 | 100.00 | 1913 | 100 |

### This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Aug. 7, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

| Week Ended | Public | Private | Total |
|---|---|---|---|
| **Aug. 7, 1928** | **$34,211** | **$43,432** | **$77,643** |
| July 31, 1928 | 36,988 | 39,391 | 76,379 |
| Aug. 9, 1927 | 33,602 | 52,530 | 86,132 |
| Jan. 1 to Aug. 7: | | | |
| 1928 | 824,454 | 1,359,619 | 2,184,073 |
| 1927 | 727,040 | 1,114,721 | 1,841,761 |

### Wages in the Building Trades of Ten Countries

The accompanying table, compiled by the Bureau of Labor Statistics, compares certain wages in the building trades of the United States and nine other countries. The figures are all in terms of United States currency.

| | Bricklayers | Carpenters | Building Laborers |
|---|---|---|---|
| Austria | $1.39 | .... | $1.12 |
| Belgium | 1.32 | $1.36 | 0.91 |
| France | 1.57 | .... | .... |
| Germany | 1.84 | 1.86 | 1.47 |
| Czechoslovakia | .... | 1.12 | .... |
| England | .... | 2.96 | .... |
| Italy | .... | 1.82 | 0.80 |
| Norway | .... | .... | 1.68 |
| Sweden | .... | .... | 3.09 |
| United States | 12.56 | 10.16 | 4.00 |

### Sand Lime Brick Produced in 1927 Valued at $4,527,184

Establishments engaged primarily in the manufacture of sand lime brick in 1927 reported a total output valued at $3,600,734, of which $3,527,184 was for sand lime brick and $73,550 for miscellaneous products, according to the Department of Commerce. Of the 44 companies reporting, twelve are in Michigan, three each in Florida, Minnesota and New Jersey, two each in Indiana, Massachusetts, New York, Ohio, Pennsylvania and Wisconsin, and one each in Alabama, California, Connecticut, District of Columbia, Georgia, Illinois, Louisiana, South Dakota and Utah. They operated an average of 201 days, compared with 217 days for 42 companies reporting in 1926, and 213 days for 41 companies in 1925.

### Structural Steel Lettings Gain

Structural steel contracts closed last week totaled 22,700 tons, compared with 20,000 in the previous week and 55,000 two weeks before. Among the larger of these were 3,000 tons for the Palm Olive-Peet Building in Chicago, 1,500 tons for a bridge in Providence, 1,300 tons for a store in New York and 1,100 tons for a Pennsylvania Railroad yard building. New projects announced call for 46,300 tons of steel.

### Some Public Bond Offerings

| *State* | Amount | Rate | Yield |
|---|---|---|---|
| Maryland | $150,000 | 4 | 4.18 |
| | 920,000 | 4 | 4.04 |
| Nebraska-Iowa bridge | 650,000 | 6½ | ..... |
| *County* | | | |
| Fayette Co., Tenn. | 600,000 | 4½ | 4.60 |
| Montgomery Co., Ohio | 108,000 | 4½ | 4.25 |
| Orange Co., Fla. | 1,100,000 | 5 | 4.70 |
| *Municipal* | | | |
| Cleveland, Ohio (school) | 1,500,000 | 4½ | 4.40@4.20 |
| Scarsdale, N. Y. | 327,841 | 4½ | 4.25 |